ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

VI

VOLUME IV. NUMBER 1

Papers from the New York Aquarium Contribution Number 10

A LIST OF

FISHES, AMPHIBIANS AND REPTILES COLLECTED IN ASHE COUNTY, NORTH CAROLINA

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The New York Aquarium, and

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PUBLISHED BY THE SOCIETY

THE ZOOLOGICAL PARK, NEW YORK

December 27, 1923

First form on press December 27, 1923.

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Introduction

The County of Ashe, North Carolina, is little known from the biological point of view and the present paper stands as the first report on the ichthyological and herpetological fauna of it. Mr. C. S. Brimley of Raleigh, N. C., states that the only other reported collection previously made within its boundaries is a small one of insects.

The area in which the specimens were collected on which this list is based is located in the central part of Ashe County and the time spent collecting in this territory extended from July 21 to August 17, 1922. This county is the most northwesterly one of the state, being bounded on the north by Virginia and on the west by Tennessee. The settlement at which headquarters were made is known to the postal authorities as Beaver Creek. It is located about fifteen miles southeast of the junction of the three states and is a typical hamlet of the southern Appalachians. All the collecting was carried on within a radius of five miles of the Beaver Creek post office, whilst by far the largest amount of it was done within less than two miles, and so represents a bit of concentrated collecting within a circumscribed area of small dimension. The land at this point is comparatively fertile and a considerable amount of it has been cleared, some quite recently, limiting the collecting grounds for terrestrial salamanders to rather well defined elevations which still in many cases are covered with the original stands of timber. Lumbering, however, is making rapid inroads on this type of territory.

In the summer of 1915, the senior author spent two months at this same place engaged in other studies and it was then that the salamander fauna forced itself on the attention. Although no definite records were kept it is certain that there has been a considerable reduction in the abundance of these amphibians for which there seems to be no very apparent reason. It hardly seems possible that the lumbering above alluded to could have annihilated the animals in such great numbers for only in occasional places has the forest floor been disturbed to any great extent. Moreover, there seems to have been a considerable change in the fauna in general. Some species now quite or nearly absent were formerly abundant and vice versa. For example, only a single specimen of the common tumble bug, *Canthon*, was seen this year while previously they were ubiquitous. On the other hand, myriapods, arachnids, birds, and mammals were about as before, whilst terrestrial gastropods have noticeably increased in number. A partial explanation may be found in the fact that this summer was somewhat cooler than the one of 1915, and while numerous thunder squalls, which quickly dried, made a wet summer as far as agriculture was concerned, it lacked the drizzles which marked that of seven years previously which kept the soil continually damp. This territory exposes rocks of pre-cambrian formation and near springs at such outcroppings much of the Urodel collecting was carried on. The altitude varies from about 3,000 to somewhat over 5,000 feet above sea level.

The fishes were collected by seine, fyke, dip net and angling gear. A small minnow seine of twenty feet was used in all waters in which its successful operation was possible, while the fyke (Fig. 4), which was likewise of small size and mesh, was set continually in the Beaver Creek, near headquarters. Small ditches, holes and backwaters were worked with a dip net. Angling was, as usual, least productive. The Beaver Creek, from which this place takes its name, runs within a few hundred feet of the post office and at this point an old time grist mill still flanks it. The section in which collecting was done wanders through tilled fields interspersed at various places by small patches of woodland. The Buffalo Creek, which drains the next valley to the northwest, a short distance on horse, empties into the north fork of the New River whilst the Beaver Creek empties into the south. These forks join at a distance of about twelve miles from the collecting site. The creeks are quite similar in general appearance, and while no great difference in the

FIG. 1. MILL HILL
The unforested ground above the cottage was formerly inhabited by great numbers of *Plethodon glutinosus.*

FIG. 2. BEAVER CREEK IN FRONT OF THE POST OFFICE
Nigger mountain in the background. Baptist church in middle ground.

FIG. 3. NEW RIVER AT THE MOUTH OF BEAVER CREEK
The water has little depth here

FIG. 4. FYKE NET SET IN BEAVER CREEK
Type of banks found in the open fields

FIG. 5. SEMI-AQUATIC HABITAT AT THE BASE OF FRENCH'S KNOB

A typical haunt of *Desmognathus*

FIG. 6. TERRESTRIAL HABITAT AT THE BASE OF FRENCH'S KNOB

A typical haunt of *Plethodon*

FIG 7 NEAR THE SUMMIT OF BLUFF MOUNTAIN
The type of rugged country encountered at the highest altitudes

FIG 8 BEAVER CREEK
View a short distance below the Post Office French's Knob in the left background

respective faunas could be noticed still there was a perceptible difference in the relative frequencies of the various species as is indicated in Table No. 1.

All amphibians and reptiles were collected by hand. Belts made similar to those used for cartridges, but instead fitted with pockets for holding tobacco tins, were found extremely useful and convenient as carriers, especially for living material of small size. Both the herpetological and ichthyological specimens were preserved in formalin in the field, and were transferred to alcohol on arrival at the laboratory. The collection has been deposited in the American Museum of Natural History with the exception of some specimens that have been retained for reference. The locations of collecting sites mentioned throughout are defined under "Distribution of fishes" or "Distribution of salamanders" on pages 13 and 19 respectively.

Dr. E. R. Dunn, of Smith College, gave very material aid in checking our identifications and in determining difficult specimens among the amphibia. Dr. G. K. Noble and Mr. J. T. Nichols permitted our use of the herpetological and ichthyological material of the American Museum, of which they have charge respectively. Mr. A. I. Ortenberger, of the same institution, aided in the determination of the snakes. To these gentlemen we are accordingly indebted and wish to here express our appreciation. Likewise we are grateful to Mr. and Mrs. R. A. Hamilton at whose home we were guests and who facilitated the collecting by their many kindnesses.

The localities, sizes, et cetera, are given in some detail, even at the risk of being accused of undue verbosity, but on account of the violent changes which have taken place in the fauna of this region in the past seven years, as before noted, it is deemed advisable to have an accurate record of just what has been collected, for purposes of future comparison. Further, it is the writers' belief that an error in this direction is preferable to one in the opposite. Such are only too often shown by regional lists of this nature. The metric system is used throughout and the measurements given for the fishes all refer to the standard lengths; that is, the shortest distance from the tip of the snout to the base of the tail. The common name or names given for each species are those by which the natives know the animals. In several cases these are rather unique. In instances where more than one is given the first is the appellation most commonly used.

Class PISCES

Family CATOSTOMIDAE

1—*Catostomus nigricans* LeSueur. Hogfish.

Ten examples of from 51 to 240 mm. were taken between July 24 and August 3, all from the Beaver Creek from a short distance above the mill to a point about one mile further down stream.

Family CYPRINIDAE

2—*Cyprinus carpio* Linnaeus. Carp.

Several of the more active natives have constructed carp ponds and have had sufficient success with them to supply their occasional demands for carp flesh. These ponds are of the simplest nature and are of small size. On account of the torrential rains common to this country the mud and silt brought down soon fills the ponds making it imperative to clean them out or build new ones. The two ponds visited were rather decadent, one appearing to be empty of fish and nearly filled with silt, whilst the other contained a fair crop of fry. Doubtless, many fishes escape from these ponds as very few safeguards have been taken to prevent losses in this manner. Such that do escape probably pass down to the relatively quiet waters of the New River in preference to the rapid mountain streams. Just why these people have taken to cultivating carp is not clear since their ponds are all fed by excellent trout streams.

3—*Campostoma anomalum* (Rafinesque). Minnow.

Of six examples ranging from 53 to 75 mm. only one was taken from the Beaver Creek, about a mile below the post office on July 28, while the remaining five were taken from the Buffalo Creek on August 12. Another of 57.5 mm. was taken from the Beaver Creek near the post office in the summer of 1915.

4—*Semotilus atromaculatus* (Mitchill). Chub, Hornyhead.

Eighty-one examples of from 35 to 154 mm. were taken. Sixteen of the smaller sized fishes were taken from the Buffalo

Creek on August 12. The remainder were taken from Beaver Creek, from above the mill to a point about one mile down stream, between July 24 and August 3. Only *Rhinichthys* exceeds this species in abundance in these waters. Many of the natives think the smaller ones are immature trout.

5—*Notropis photogenis photogenis* (Cope). Minnow.

Five examples of from 63 to 73 mm. were taken from the Beaver Creek within sight of the mill from July 24 to August 3. This record stands as an addition to the fish fauna of North Carolina. The almost indistinguishable race, *amoenus,* well known from the coastal plain drainage, is replaced by *photogenis* in this territory which is Mississippian, as should be expected. In comparing these fishes with specimens in the American Museum of Natural History, there was found a somewhat larger individual, identical with the present material, which had been collected by Morton L. Church, at Marshall, N. C., that had not been recorded. Dr. Henry W. Fowler, of the Philadelphia Academy of Natural Sciences, kindly examined these specimens and considers them unquestionably *photogenis*.

6—*Rhinichthys atronasus* (Mitchill). Minnow.

One hundred and five examples of from 20 to 68 mm. were taken. Eighty-six were taken from the Beaver Creek, from above the mill to about a mile below it, from July 24 to August 3, whilst the remainder were taken from the Buffalo Creek on August 12. This species was particularly abundant, the smaller ones finding their way into the most tiny trickles whereas the larger examples were usually schooled up in shaded holes in the larger branches and creeks. Seen in the New River on August 13.

7—*Hybopsis kentuckyensis* (Rafinesque). Hornyhead, Minnow.

Three examples of from 109 to 110 mm. were taken from the New River at the mouth of the Beaver Creek on August 13 by hook and line.

Family SALMONIDAE

8—*Salmo irideus* Gibbons. Rainbow Trout.

Reported by natives, who stated that a plant was made by the United States Bureau of Fisheries some years ago and that occasional examples have been taken since that time of under a foot in length. None seen by us.

9—*Salvelinus fontinalis* (Mitchill). Speckled or Brook Trout.

Two immature examples of 119 and 163 mm. were taken on July 24 from the Beaver Creek above the mill. The stomach of the smaller example contained a crayfish about 12 mm. long and the larger one was full of insect fragments. Some years ago plantings of this species were made by the Bureau of Fisheries and these may be of that stock as lumber camp polutions practically wiped out the native trout some years back. Since then protective legislation has checked the contamination from them and the streams appear to be well recovered.

Family CENTRARCHIDAE

10—*Ambloplites rupestris* (Rafinesque). Redeye, Rock Bass.

One example of 141 mm. was taken from the New River by angling, slightly above the mouth of the Beaver Creek (Figure 3), on August 13. Others of smaller size were seen at this time.

Family PERCIDAE

11—*Etheostoma flabellare* (Rafinesque). Young Hogfish.

Ten examples of from 18 to 36 mm. were taken from Beaver Creek between a point slightly above the mill and one about a mile below it. The natives consider this the young of *Catostomus*.

Family COTTIDAE

12—*Cottus ictalops* (Rafinesque). Poisonhead.

In the summer of 1915 this was one of the most abundant forms of fish life at this place, a simple seine made of a gunny sack often bringing up a dozen or more from a short haul. One specimen preserved at the time measured 61 mm. and was about the average size. A diligent search of all the waters in 1922 failed to reveal a single individual, and the crop of small boys that have sprung up in the intervening seven years do not know the name 'Poisonhead.' The small boys of 1915, no longer such, aver that they do not remember having seen any for a long time. The various small cyprinids on the other hand seem to be more abundant.

Distribution of Fishes at Beaver Creek

Table No. 1 lists the species collected according to the three chief sites with reference to their relative abundance. The locality called Beaver Creek includes a stretch of that stream of about two

miles in extent, reaching from a point about three-quarters of a mile above the post office to one about one and one-quarter miles below it. It is here that most of the collecting was carried on and includes all the confluents of this stream between these two points. The other two localities were visited but once each. The Buffalo Creek was collected in, over a stretch of about one half mile, at the base of the northwest side of the Paddy Mountain. The south fork of the New River was angled in only, close to the mouth of the Beaver Creek.

TABLE NO. 1

DISTRIBUTION OF FISHES

Species	Beaver Creek	Buffalo Creek	New River
1 *Catostomus nigricans*	Common	Reported	Reported (large)
2 *Cyprinus carpio*	Known from fish ponds only		
3 *Campostoma anomalum*	Occasional	Common	——
4 *Semotilus atromaculatus*	Abundant	Abundant	——
5 *Rhinichthys atronasus*	Abundant	Abundant	Common
6 *Notropis p. photogenis*	Occasional	——	——
7 *Hybopsis kentukyensis*	——	——	Common
8 *Salmo irideus*	Reported	——	——
9 *Salvelinus fontinalis*	Not scarce	Reported	Reported
10 *Ambloplites rupestris*	——	——	Common
11 *Etheostoma flabellare*	Rather common	——	——
12 *Cottus ictalops*	Absent, formerly abundant	——	——

Class AMPHIBIA

Order CAUDATA

Family CRYPTOBRANCHIDAE

1—*Cryptobranchus alleghenensis* (Daudin). Water Dog.

Reported by natives from both the New River and Beaver Creek. The bed of the creek was recently shifted near West Jefferson for some road building operations and as a result several were noticed by the engineers who gave a fair description. No examples were seen by us.

Family SALAMANDRIDAE

2—*Triturus viridescens viridescens* Rafinesque. Water Lizard.

Described by natives from a carp pond near Jefferson. On search we failed to find any, but very likely they occur here sparingly as the natives' descriptions were reasonable.

Family PLETHODONTIDAE

3—*Plethodon cinereus* (Green). Wood Puppy.

Common in damp woods of not over 4,000 feet elevation. Taken on Mill Hill, near the Baptist church, and at the base of French's Knob under damp litter, between July 22 and August 3. A curious feature is that out of the thirty-two individuals which varied from 34 to 76 mm. and numbers not collected, only a few with red backs were seen. This is especially interesting since Dunn[1] in taking forty-eight specimens at Linville (thirty-three miles southwest of here) writes "only two had black backs."

Apparently this species holds the lower grounds as none were taken on the higher mountains. On the sides of Bluff Mountain it appears to be replaced by *P. metcalfi*. At least it is strange that the only place from which we took that species the present was absent. The point of greatest abundance for *cinereus* in our territory was the small patch of damp woods behind the Baptist church. Here large numbers of these supple little gray salamanders could be taken with slight effort.

4—*Plethodon glutinosus* (Green). Wood Puppy.

Abundant. Taken in a large variety of both damp and dry localities. Numbers were seen which were not collected, a few even in parched fields of stubble under stones or bits of wood of small size. Sixteen were collected ranging in size from 44 to 157 mm. between July 23 to August 2 from the following places: Mill Hill, damp woods; near Baptist church, damp woods; Base of French's Knob, damp woods; Bluff Mountain, damp woods; Buck Mountain, near Mica Mine; Southwest slope of Nigger Mountain, both damp and dry localities.

5—*Plethodon metcalfi* Brimley. Wood Puppy.

Taken only on Bluff Mountain in damp woods as follows: 93, 98, 111 and 113 mm. The first varied from the typical *metcalfi* in that it possessed a few pigmentless areas on the sides which gave it a resemblance to *P. glutinosus*. Thus far all specimens of *metcalfi* have agreed in the uniformity of the gray coloration on the back and sides. This individual demonstrates that *metcalfi* may approach *glutinosus* in coloration by occasionally possessing these white spots

[1] Dunn, Emmet R. Reptile and Amphibian Collections from the North Carolina Mountains with especial Reference to Salamanders. Bull. Amer. Muse. Nat. Hist. Vol. XXXVII, Art. XXIII, Oct. 13, 1917, N. Y.

even as the converse is true in that *glutinosus* sometimes lacks them. The presence or absence of these spots can therefore be used no longer by itself as a simple means of separating the two.

6—*Plethodon yonahlossee* Dunn. Wood Puppy.

One adult of 131 mm. was taken from under a rotten log on the damp southwestern slope of Mill Hill, July 26. Two young of 48 and 47 mm. on Nigger Mountain and two young of 64 and 56 mm. on Bluff Mountain. The young all showed the characteristic spots. These altitudes are slightly less than that of the type locality, they being from 3500 to 4000 feet whereas the latter was between 4100 and 4400. This is the most northerly record for the species.

7—*Eurycea bislineata wilderae* Dunn. ————

This recently described race[2] was taken in a variety of places, usually damp, although it was found further from water and in drier places, at times, than the writers had ever seen *bislineata* in the latitude of New York City or Washington, D. C. Five adults were collected from July 25 to August 8 varying from 28 to 71 mm. at these places: Mill Hill, both damp and relatively dry woods; near Baptist church, in spring; Bluff Mountain, in spring. The specimen of 28 mm. which was taken in a spring near the summit of Bluff Mountain presented an unusual type of coloration. The usual yellowish back, bordered with a black line on either side, was replaced with a ground color of dusky brown. This color extended downwards to the insertion of the limbs, and only a faint suggestion of the black lines of typical individuals was present. About six lighter brown spots followed both these suggestions of lines at their dorsal edge between the fore and hind limbs. They showed a slight tendency towards occelation, as did other less conspicuous markings on the caudal region. These markings were not widely different from those of some of the larvae which seem to have a considerable range of individual variation. However, this specimen showed no larval fin fold or other immature characteristics and appeared to be fully metamorphosed, although it was smaller than some larvae we took, our largest being 32 mm. as against the 28 mm. of this example. Taxinomically, it otherwise checks well for this

[2] Dunn, Emmet R. Some Reptiles and Amphibians from Virginia, North Carolina, Tennessee and Alabama. Proc. Biol. Soc. Wash., Vol. 33, pp. 129–138, Dec. 30, 1920.

species and we believe it can be put down simply as an abnormality. The larval material was taken from the following places:

Spring near summit of Bluff Mountain. One 32 mm. in company with the above described specimen and one adult of 30 mm., August 8.

Spring near look off rock on Nigger Mountain. Temperature of water 54° F. Ten, 17 to 27 mm., August 9.

McKeever's spring, northeast base of Nigger Mountain. Temperature of water 48° F. Seven, 27 to 33 mm., August 9.

8—*Pseudotriton ruber niditus* Dunn. Red Lizard.

Four examples were seen, two of which subsequently escaped. The others represented the two most extreme types of variation of this race as yet seen by the describer. Both of these were in exceptionally dry places and only about a mile apart.

One near the Baptist church, on a hillock taken July 28, measuring 96 mm., was very lightly speckled with small black punctulations on the back, hardly any of which extended beyond the insertion of the hind limbs. The appearance in life was a brilliant waxy red, the subspecific designation being especially appropriate for this individual.

The other on Mill Hill, at the edge of dry field, taken on July 31, measuring 85 mm., was covered with black spots of a heavy sort extending nearly to the tip of tail, although there was no tendency for the larger ones to fuse as in *ruber*. Neither was there any smaller stippling interspersed between the larger spots.

Larvae were taken as follows: Mill Hill, July 25, 42 and 37 mm.; Bluff Mountain, August 8, 29 mm.

9—*Desmognathus fuscus fuscus* (Rafinesque). Wood Puppy.

This widely distributed form was not hard to find but by comparison with *D. monticola* was not abundant. Fifteen specimens were taken between July 25 and August 9 which varied from 46 to 75 mm. from the following places: Mill Hill, at the water's edge and in springs; near Baptist church, in a nearly stagnant trickle; base of French's Knob, in springs; Nigger Mountain, in spring near look off rock. In the two highest places in which taken (Mill Hill and Nigger Mountain) this species accompanied *D. monticola* whilst the latter was absent from its two lowest environments (near the Baptist church and at the base of French's Knob) although the

forest floor in all four cases was generally similar. Not seen in places as dry as those in which *monticola* was at times.

10—*Desmognathus monticola* Dunn. Wood Puppy.

Abundant in damp and wet places up to 4,500 feet. Eighty-six were taken which varied from 23 to 125 mm. between July 25 and August 14 from the following places: Mill Hill, stream edge and damp places; Nigger Mountain, springs and damp woods; Bluff Mountain, damp woods; base of Paddy Mountain, spring; base of Mulatto Mountain, spring. While usually associated with dampness, they were frequently found considerable distances from water as compared with *fuscus* from here or other places.

11—*Desmognathus ochrophaeus carolinensis* Dunn. - Wood Puppy.

This more terrestrial species of *Desmognathus* was taken in a wide variety of places. Twenty-nine individuals were taken between July 25 and August 9 which ranged from 19 to 90 mm. from the following localities: Mill Hill, dry woods; Nigger Mountain, dry woods, springs, and in a cave-like grotto; foot of French's Knob, damp woods; Bluff Mountain, damp woods; Buck Mountain, near Mica Mine; Hayfield, near edge of spring.

12—*Desmognathus quadra-maculata* (Holbrook). ————

Taken in and at the edge of small streams, usually less than one half mile from their origin. Dunn states, "Around Brevard they come down to 2100 feet in large streams."[3] As none of our territory was of much less elevation than 3000 feet we have no data on their environment below that level, but none that we saw were in streams over three feet wide, although we should have taken them, if present in the larger creeks on account of the ichthyological collecting. The locality of their greatest abundance was at a height of 4300 feet near the summit of Bluff Mountain. Here in a stream rising from a spring about a mile back from the bluff this species was particularly common. They were taken as near to the precipice as we dared approach with collecting in mind, at which point a picturesque streamlet with an average depth of about two inches and a width of about three feet plunged nearly vertically to the valley over eight hundred feet below. One of the individuals taken there was marbled all over with lighter, but is undoubtedly referable to this species nevertheless. One larval example of 55 mm. was taken in a

[3] See footnote 1, page 14.

spring on Buck Mountain near the Mica Mine. Another larva of 52 mm. was taken in the stream at the Bluff. Adults were taken in springs and streams on Mill Hill, Nigger Mountain and Bluff Mountain, as before noted, to the number of nine between July 25 and August 8 which varied from 55 to 110 mm.

Distribution of Salamanders at Beaver Creek

In Table No. 2 the species collected are arranged according to the chief localities. Those localities mentioned in this table that can not be found on the Cranberry or Wilksboro sheets of the United States Geological Survey map are explained below.

Mill Hill—A wooded hillock of 3400 feet on one's right if facing down stream at the Beaver Creek post office. See Figure 1.

Baptist Church—A small glen behind a church of that denomination about a quarter mile down stream from Beaver Creek. See Figure 2.

Rail Road Hill—A hill of 3200 feet, across the rail road from the post office, at a point about one quarter mile below the station.

French's Knob—A densely tangled rise of land of 3600 feet, about one mile southeast of Beaver Creek. The northwest base was collected on very successfully. See Figures 5, 6 and 8.

Mica Mine—A mine for high grade mica, now not in use, on the Buck Mountain is here referred to. It was in its near vicinity that the specimens were taken.

Carp Pond—A disused carp pond near Jefferson on the property of Mrs. C. Neal.

Order SALIENTIA

Family BUFONIDAE

1—*Bufo americanus* Holbrook. Toad Frog.

Abundant. Many were seen, including practically all stages except the eggs. Eight adults measured as follows in head and body lengths, 105, 97, 86, 83, 73, 71, 65, 62 mm. The two smallest ones were decidedly reddish but lacked the drak throat patch characteristic of the male. One immature example of 8 mm. was nearly as red as the terrestrial form of *Triturus viridescens*. The natives consider these another species, calling them Red frogs and tell wonderful tales of how they descend in the rain. The great numbers

TABLE NO 2

DISTRIBUTION OF SALAMANDERS

Species	Beaver Creek	New River	Mill Hill	Nigger Mount	Bluff Mount	Baptist Church	Rail Road Hill	French's Knob	Mica Mine	Paddy Mount	Carp Pond
1 *Cryptobranchus alleghenensis*	Reported	Reported	—	—	—	—	—	—	—	—	—
2 *Triturus v viridescens*	—	—	—	—	—	—	—	—	—	—	Reported
3 *Plethodon cinereus*	—	—	Common	—	—	Abundant	—	Scarce	—	—	—
4 *P glutinosus*	—	—	Common	Not rare	Not rare	Common	1 small	Common	Not rare	—	—
5 *P metcalfi*	—	—	—	—	Not rare	—	—	—	—	—	—
6 *P yonahlossee*	—	—	1 adult	2 young	2 young	—	—	—	—	—	—
7 *Eurycea bislineata wilderae*	—	—	1 adult	Larvae common	Not rare	1 adult	—	1 adult	—	—	—
8 *Pseudotriton ruber nitidus*	—	—	1 adult 1 larvae	—	1 adult 1 larvae	2 adult	—	—	—	—	—
9 *Desmognathus f fuscus*	—	—	Not rare	1 small	—	Not rare	—	Not rare	—	—	—
10 *D monticola*	—	—	Common	Abundant	Common	—	—	—	—	Abundant	—
11 *D ochrophaeus carolinensis*	—	—	Not rare	Common	Common	—	—	Not rare	1 small	—	—
12 *D quadra-maculata*	—	—	Common	Not rare	Abundant	—	—	—	1 larvae	—	—

in which small toads of this size appear in these mountains after a cloudburst is nevertheless extremely impressive. Tadpoles in various stages were seen as late as August 16.

Family RANIDAE

2—*Rana catesbeiana* Shaw. Bull Frog.

A single specimen of 91 mm. was taken in the minnow fyke in the Beaver Creek, near the post office. A number were heard along the New River on August 13 at mid-day in fair hot weather.

3—*Rana clamitans* Latreille. Frog.

Two tadpoles of this species 70 and 53 mm. long were seined in the Beaver Creek about one mile below the mill on July 28. No adults were seen.

4—*Rana palustris* LeConte. Frog.

Several examples were seen in the meadows about Beaver Creek.

5—*Rana sylvatica* LeConte. Frog.

One example of 30 mm. was taken on July 31 on the east side of Mill Hill at the edge of a dry woods. This individual departed from the typical *sylvatica* in that its back was markedly rugose, but in other respects was perfectly normal.

Class REPTILIA

Order SQUAMATA

Suborder SAURIA

Family IGUANIDAE

1—*Sceloporus undulatus* (Latreille). Scorpion, Fence Lizard (rare).

This species which the natives hold in unnecessary awe was seen quite frequently, being percehd as usual on old fence rails in the hot sun. Only two specimens were taken as there seemed to be no very good excuse for destroying numbers of these harmless and interesting lizards. One was a typical male of 135 mm. and the other a female of 134 mm. Both had their stomachs crammed full of fragmentary insects, most of which seemed to be coleopterous. July 27 and 28 are the respective dates of capture. On August 15 near the crest of Mill Hill in a clearing an individual was noted which was blotched with whitish. Partial albinism was thought of, but when the animal allowed itself to be picked up and handled without attempting to escape it seemed likely that some disease

afflicted the creature. It was allowed to perch freely on the finger, and strangely enough permitted a stroking of the white spots, responding only by craning its neck and blinking its beady eyes. This gentle stroking caused the scales to drop off in a shower of dandruff-like flakes and it was then obvious that the animal was merely shedding, as beautifully brilliant scales appeared wherever the old ones fell from. After a few minutes of this sort of treatment it decided it had stood for enough and with one powerful leap left the scene. Subsequent examination of the shed scales showed that they had completely sheathed the new formation simply tearing away all around the base. The whitish appearance is accounted for by the fact that air found its way between the loose old scales and the new. This contrasts strongly with such fine scaled forms as *Anolis* in which the epidermis is cast off in large patches, sometimes the entire covering coming away almost as one piece.

Suborder Serpentes

Family COLUBRIDAE

1—*Carphophis amoena* (Say). Snake.

Two examples of 23 and 28 cm. were taken between July 27 and 31 and one of 24 cm. in 1915. A few others were seen, all in typical localities under stones and rubbish. The natives hardly know this unobtrusive form.

2—*Diadophis punctatus edwardsii* (Merrem). Snake.

Three examples from 29 to 35 cm. were taken in places similar to that of the above and usually close by between July 27 and 30. Numerous others were seen.

3—*Elaphe obsoleta obsoleta* (Say). Black Snake.

One example of 168 cm. was taken from the north side of the Mulatto Mountain on July 31. It is said to be fairly common by the natives, who hold it to be poisonous.

4—*Lampropeltis triangulum triangulum* (Lacepede). Snake.

One example of 49 cm. was taken at Beaver Creek on July 22. Not recognized as a distinct species by the inhabitants of that place.

5—*Natrix septemvittata* (Say). Water Snake, Water Moccasin.

Three examples all in the vicinity of water, varying from 28 to 61 cm. in length were taken between July 22 and August 11. The natives, are not sure as to whether these are dangerous or not.

6—*Natrix sipedon fasciata* (Linnaeus). Water Snake, Water Moccasin.

Two examples, 71 and 79 cm. were taken near water on August 3 and 11. Many others were seen, it being a very common form in this vicinity. The natives confound this with the preceding species.

7—*Thamnophis sauritus* (Linnaeus). Snake.

One example from near the base of Buck Mountain was taken on August 11. It measured 54 cm. in length.

8—*Thamnophis sirtalis sirtalis* (Linnaeus). Snake.

Three examples from 56 to 105 cm. in length were taken between July 22 and August 13. The largest one was about to give birth to thirty-seven young which varied from 14.0 to 17.2 cm. and showed a mode of 16.0. A common species.

Family CROTALIDAE

9—*Crotalus horridus* Linnaeus. Rattlesnake, Rattler.

The natives hold this snake in great fear and report that it is common and especially abundant at certain places. A careful though unsuccessful search was made both in 1915 and 1922 in the vicinity of reputed "dens." Once did the junior writer believe a specimen was seen but it slipped away amid a pile of debris too rapidly for positive identification. Not one was definitely seen by us and it may be significant that not an individual questioned had a rattle to show as evidence. As boys living in areas infested with these reptiles usually have a few sets of such mementoes we infer that the species is not common in this vicinity.

Order TESTUDINATA

Family CHELYDRIDAE

1—*Chelydra serpentina* (Linnaeus). Terrapin.

One specimen was seen with a carapace of 102 mm. It was typical and was taken in a small swamp near the north side of the Mulatto Mountain. This species is said not to be uncommon by the

natives, who relish it as food. *Chelydra* is known in this region simply as Terrapin while all others are known as Dry-land Terrapin whether they are aquatic in habit or not. The shorter and less cumbersome names of Turtle and Tortoise are unknown terms to most of these mountaineers.

Family TESTUDINIDAE

2—*Clemmys muhlenbergi* (Schoepf). Dry-land Terrapin.

Two specimens were taken, one of which subsequently escaped. The measurements of the other were as follows. Carapace length 91.5 mm., width 69 mm., plastron length 80 mm., width 56 mm., length of tail (vent to tip) 17 mm., head width 17 mm. Carapace brownish black, no blotching whatsoever. Plastron with light brown and yellowish blotching, bridge similar. Nuchal plate 6 mm. Taken near the Baptist church on July 28 in a discarded horse trough.

PROBLEMS AND FACTS
ABOUT FROZEN SIBERIAN MAMMOTHS
(*ELEPHAS PRIMIGENIUS*) AND THEIR IVORY[1]

By Herbert Lang

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(Figs 9 to 19 Incl.)

Centuries ago rumors of the discovery in northeastern Asia of great curved tusks of ivory persistently drifted into Western Europe. Could it be true that animals apparently surpassing an elephant in size lived on the bleak tundra of northeastern Siberia? Did it not sound like a fairy story that such gigantic beasts burrowed and lived underground somewhat like our tiny moles?

Ides, the famous Dutch traveler and ambassador to China, seems to have been the earliest to gather first-hand information. On traversing northern Siberia between the years 1692 and 1695 he learned that many of the Yakuts, Tunguses, and Ostyaks steadfastly believed that these huge monsters spent their lives deep underground, moving about easily in spacious tunnels even though the earth was thoroughly frozen. Should they become particularly active the whole ground might rise above them, caving in later as they passed on. But let the "mamonts" or "ground-dwellers" come to the surface and breathe the warm air, they instantly died.[2]

This is not so strange a story when we consider that actual circumstances helped strengthen native belief. At certain places in Siberia, after the melting of the snow, plenty of bones of what later came to be called the mammoth were lying about the surface or sticking up from the ground. Here and there after the thawing and slipping of portions of steep river banks the more or less complete remains of these proboscideans had been exposed to view in the very sites where inadvertently they might have reached the fateful daylight. At other times one of these frozen giants was discovered at a point the natives imagined to be the end of the mammoth's diggings.

[1] The photographs and some of the data in this article have been kindly contributed by Dr. E. W. Pfizenmayer, Curator, Natural History Museum, Stuttgart. Formerly: Assistant, Petrograd Zoological Museum; Member of the Beresovka Mammoth Expedition; Leader of the Sangajurach Mammoth Expedition.

[2] Ides, Isbrand, 1704, 'Dreyjarige Reize naar China.' Amsterdam, p. 31.

First form on press January 5, 1925.

Fig. 19 —The famous frozen mammoth of the Indigirka River, Siberia From Beukendorf's romantic story, Mrs E Rungius Fulda pictures the ice-mummy with hind limbs still anchored in the unthawed banks Later, when the ground, together with the mammoth, was carried away by the force of the onrushing floods, the discoverers had a narrow escape Reproduction from W. T Hornaday's "Tales From Nature's Wonderland." Copyrighted by Charles Scribner's Sons.

It is with amusement we turn to the many heated, rather sprightly controversies that centered about the early finds in Europe of certain fossil bones of enormous proportions. Did they belong to giants? Certainly the few pieces available showed a more striking resemblance to those of man than to any other quadruped they could then be compared with. In Switzerland, after unearthing in 1577 some of these huge bones, the city elders of Lucerne desired to express pride in what they were pleased to consider their giant ancestor. After many enthusiastic comments they decided to figure him as bearer of the town escutcheon. More remunerative proved the resurrection of the supposedly nineteen foot tall Cimbrian king Teutobochus in 1613 near Montrigaud (Drôme), in southeastern France. The astute surgeon Mazurier arranged a traveling show, making the curious crowds pay for the pleasure of viewing the relics.

After parts of skulls, molars, and tusks had finally been obtained there was of course no question as to their belonging to some kind of elephant. Cuvier, who was the founder of the Department of Palaeontology in the Paris Museum, was the first to recognize that these gigantic bones exhumed in Western and Central Europe and the frozen remains in northeastern Siberia belonged to the same kind of animal, the extinct mammoth *Elephas primigenius*.

There was naturally a keen desire on the part of the more enlightened to recover for scientific purposes at least one of the ice-mummies, soft parts and all. As early as 1722 Peter the Great of Russia gave orders to that effect to the governor of Siberia. From time to time quantities of bones collected apparently at random were sent in. Small portions of the coveted quarry occasionally reached interested centers and kept alive the yearning for real success. But in the hope of securing more complete remains the Petrograd Academy of Science before the close of the century sent several expeditions into Siberia to have exceptionally promising finds followed up, exhumed if possible, and transported to their zoological museum.

During those early periods travel into such desolate, far-off regions was a slow and difficult process and rendered even the most hopeful of these enterprises uncertain. By the time adventurous men of science made their way over thousands of miles, the particular frozen mammoth whose quest called them into the howling wilderness had literally melted away. Exposed soft parts rapidly decayed or were destroyed by carnivores that often scattered the

bones. Floods frequently carried whole portions away, or else the oncoming winter thwarted all further attempts at recovery.

Not until 1806, however, came the really epoch-making find which solved many questions about this extinct form. A Tungusian fisherman in 1799 had located a complete, frozen mammoth on the banks of the Lena River at the threshold of the Polar Sea. Imbedded in ice, as it had been for thousands of years, its meat was still in such condition as to be eagerly devoured by polar bears, wolves, and other carnivores attracted from great distances. As time went on every warm season bared more of the body; only the natives contested the booty by securing some of the meat for their dogs through the following years of exposure. It was then that the intrepid explorer and botanist Adams happened to arrive in the neighborhood and, hearing of the famed monster, lost no time in reaching it. Most of the soft parts were gone, one limb had been carried away, and a native had sawed off both tusks and sold them for about fifty rubles. Through Adams' energy and foresight practically all remaining bones were collected. He also took to Petrograd a piece of the hide with the hair in place. It was from the still frozen side upon which the mammoth lay, and so heavy as to tax the strength of ten men to drag it along the shore. A large amount of loose, coarse hair, evidently trampled into the snow by feasting polar bears, was long enough to be considered as having formed a mane.

This mounted "Adams" mammoth, to which some of the dried parts were left adhering, served Tilesius[3] as a basis for the first figure of a complete skeleton, which by the way measures nine feet eleven inches at the shoulder and remains even to-day the largest ever recovered from Siberia. An Indian elephant from Ceylon but three inches less in height weighed 8,700 lbs. G. Cuvier soon after copied the figure of the Adams' skeleton in his famous work on fossil bones.[4] Subsequently the same illustration found its way into nearly every scientific text book and is still used in the eleventh edition of the Encyclopedia Britannica. It also was taken as a model for the setting up of practically all fossil mammoths found in Western Europe. Unfortunately it was far from satisfactory. The missing tusks of the mammoth had been replaced by com-

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[3] 1815, Mém. Acad Imp. Sci., St. Petersbourg, V, Pl. X.

[4] 1821, 'Recherches sur les Ossemens fossiles.' Nouv. ed., I, Pl. XI, opp. p 204.

Fig. 9. The steep slope where the Beresovka frozen mammoth was discovered. Masses of thawed ground slipped and uncovered the ice-mummy that reposed here perhaps anywhere from 12,000 to 25,000 years

Fig. 10 The Beresovka mammoth ice-mummy in process of being recovered, after the debris had been cleared away and two-thirds of the frozen body exposed to view. The skull, in the upper left corner, has been cleaned of all flesh.

bining several other pieces of ivory. According to later authorities[5] these substitutes do not correspond in either size, length, direction, or curvature with those this huge bull originally seemed to have carried.

For nearly a hundred years after Adams' mammoth skeleton had reached Petrograd no important contributions were made in this line. Attempts to secure the entire frozen remains of some of the most promising of the twenty-one finds recorded during this period resulted practically in failure. They were too widely scattered over the bleakest of ice-bound solitudes, mostly in regions beyond the Arctic circle. Here nature seemed to be intent on holding on to one of its most fanciful creations—ice-mummies.

Several Alaskan mammoths in a very much poorer and more fragmentary state were also investigated. The great credit for the rapid advance of our knowledge about frozen mammoths is due chiefly, however, to the extraordinary success of the three following expeditions: Herz-Pfizenmayer, on the Beresovka, a right tributary of the Kolyma River, Arctic Ocean drainage, Province of Jakutsk, 1901–1902; Pfizenmayer-Vollosovic, on the Sangajurach River, in the Arctic coast region opposite the New Siberia Islands, 1908; and Vollosovic, on the Liakhoff Islands, southernmost of the New Siberia Archipelago, Arctic Ocean, 1912–1913.

The Beresovka Expedition was the first to profit by the rapid transportation facilities of the then new Trans-Siberian Railway. But even from Irkutsk, the last railroad station on their route, nearly 4,500 miles had to be covered on foot, horseback, and sleigh to the Beresovka River and back. In order to continue the work of salvage in the intense cold a hut had to be built over the partially exposed remains and stoves kept burning. After tremendous hardships and in the incredibly short time of ten months all that was worth while to be had of the mammoth was transferred to Petrograd. As it reached there the middle of February, most of it was still in frozen condition. This was the first time that the almost complete skin of any fossil mammal could be mounted for exhibition. Nearly all the hair had come off but some of it was put back later. For many reasons it was found advisable to represent the mammoth in the position in which it had met its untimely death. Careful study of the exceptionally perfect skeleton of this young bull, in which but one tusk was lacking, brought out many points of

[5] Pfizenmayer, E. W., 1907, Ann. Rept. Smithsonian Inst. for 1906, Washington, p. 332.

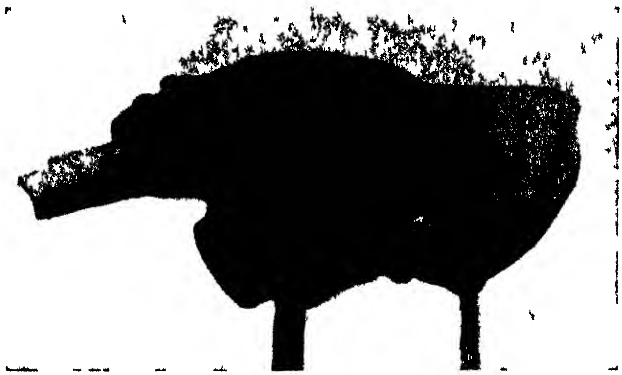

Fig 11 Skull of the adult female Sangajurach mammoth with soft parts removed except about upper portion of face Tusks of female elephants being easily detached especially after a slight amount of decay, in this case they were not recovered

interest. Modern scientific methods of collecting made possible a number of unique results in the study of various parts, such as tongue, feet, tail, stomach, muscles, hide, fat, blood, as well as its food. (Figs. 9, 10, 17, and 18.)

The Sangajurach Expedition, under the leadership of Dr. Pfizenmayer, seemed at first but little favored, for the greater part of the mammoth had been washed downstream or destroyed by Arctic foxes before the party arrived. But some lucky cause had

Fig. 12. Portion of the trunk of the Sangajurach mammoth, showing essentially the same structure as those of living elephants Near the lower part, to the left, a piece of the dense hair cover

preserved large pieces of the hide of the body and limbs with complete hair covering in place (Fig. 15). Even more fortunate was the recovery of some of the upper portions of the head and the nearly complete trunk (Figs. 11 and 12). In the case of the Beresovka ice-mummy the destruction of these particular parts as well as of the back by decay and carnivores had been a keen disappointment to all at the time.

The Vollosovic Expedition was financed by Count Stenbock-Fermor, who presented the results to the Paris Museum. This mammoth proved to be in as good condition as the Beresovka specimen and has helped to confirm and extend many of the researches made on the material from the two Russian expeditions.

Following this the late Czar issued an imperial ukase prohibiting the exportation of any mammoth or parts thereof found in Russian territory, reinforcing a former order whereby all mammoth ivory and bone had to be submitted to a committee appointed by the Petrograd Academy of Science, that might retain any parts desired.

The field observations and researches based upon the wonderfully well preserved material from the Beresovka and Sangajurach mammoths settled a number of disputed questions. Different phases of the life history of the fabulous monsters of the frozen tundra were finally cleared up, such as appearance, structure, size, habits, and even relationship. No other fossil type has left such remarkably complete data as the Siberian mammoth and to a lesser extent its partner, the woolly rhinoceros.[6]

Apart from its shaggy coat the main distinctions between the Siberian mammoth and living elephants were its much shorter, more massive body and above all its large, bulky head. The big skull had to furnish support to the enormous, spiraled tusks and weighty molars.

As in recent elephants the tusks are variable in form and much smaller in the females. Their sockets run nearly parallel. At their point of emergence from the skull the tusks first diverge—sideward, forward, and upward—and then slightly converge in the general direction of the shoulder, with tips curved inward and downward.

The tremendous size and peculiar shape of mammoth tusks have aroused many discussions. Was so excellent a student as Adams[7] right when he suggested that the hooked extremities thereof

[6] Preserved parts of a mammoth and rhinoceros were also unearthed in 1907 in pits of mineral wax in Starunia, Galicia (Poland)

[7] Adams, Andrew Leith, 1870, 'Notes of a Naturalist in the Nile Valley and Malta.' Edinburgh, p. 231

Fig 13 An abnormally spiraled mammoth tusk Perhaps all the part rooted in the socket, and more, is missing From the worn tip one might presume the ivory was a bothersome burden for its bearer Much rubbing at that point somewhat reduced its thickness

may have been "used for pulling down and retaining branches of lofty coniferous and other trees"? Or is there reason to follow Pfizenmayer in his explanation that some apparently abnormal tusks with obliquely forward and downward directed tips served to break the crust of snow and scrape together food? Did these tusks grow to such gigantic proportions merely so the males might have a better chance to secure plenty to eat? Seldom would they care for the weaker among them. Nature would not treat in so step-motherly a fashion females and young, on whose welfare the continuity of the race depends.

In nearly all larger mammals the horns, antlers, and tusks serve essentially as weapons. In each case they are applied in the most suitable fashion. Among elephants the strongest bull of the herd enforces his right to perpetuate the race by battering every contestant with his tusks. Just one wrong blow during the fury of a contest and these ivories snap off like glass. Not rarely have large African bull elephants left one of their tusks on such battlefields.

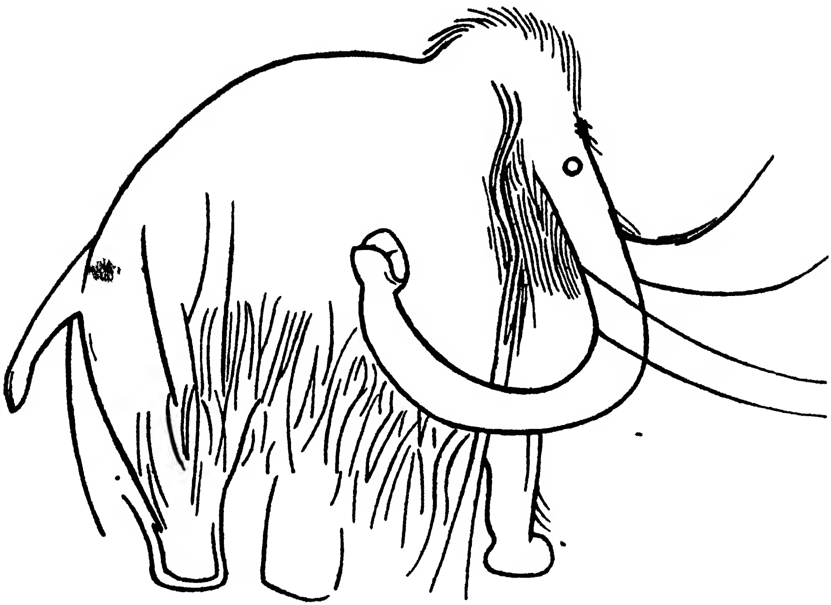

Fig 14 Outline engraving of woolly mammoth carved by Aurignacian man of early Magdalenian times on the rocky walls of the cavern at Combarelles, Dordogne, France. After Capitan and Breuil, 1901.

Of course the extremely large, recurved tusks of mammoths, describing in many specimens fully three-quarters of a circle, undoubtedly became useless even for such a purpose. Neuville may be correct in looking upon them as more embarrassing than useful and as showing degenerating influences at work.

The largest Siberian mammoth tusk, preserved in the Petrograd Zoological Museum, measures along the outside curve thirteen feet seven and three-quarter inches, and weighs 186 lbs. The American Museum of Natural History possesses one from the Liakhoff Islands somewhat heavier, weighing 200 lbs., but only twelve feet eleven inches in length, with a greatest circumference of twenty-one inches. Lucas[8] reports one from Alaska but slightly smaller, twelve feet ten inches.

The trunk, as instanced by the Sangajurach specimen, from which only the tip was lacking, was dwarfed and weak in comparison with those of recent elephants. With all proboscideans it is an important organ, the corner-stone of touch, scent, respiration,

[8] Lucas, F. A., 1901, Ann. Rept. Smithsonian Inst for 1899, Washington, p. 355

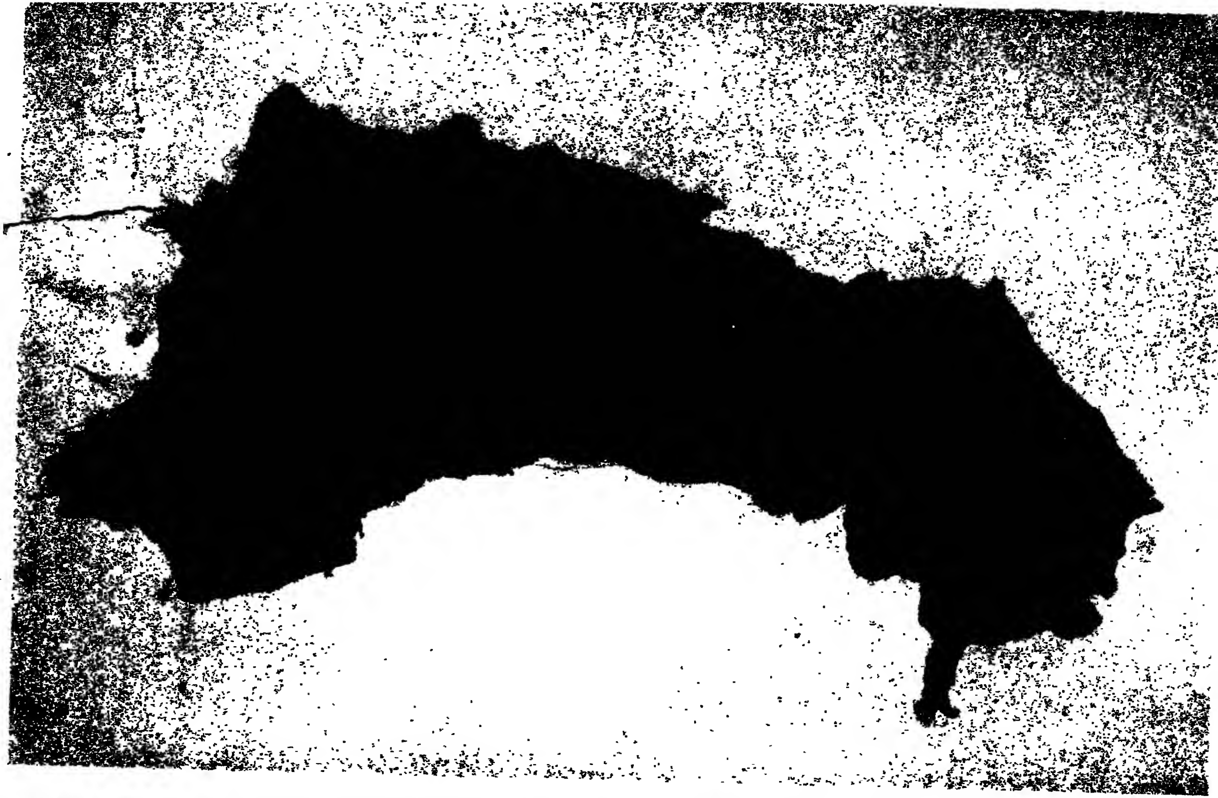

Fig. 15. A piece of frozen mammoth skin from the upper part of the thigh with most of the hair still in place. Where longest this shaggy coat measured about one foot six inches. From the Sangajurach specimen.

and constantly used to secure food and drink, as well as for defensive and offensive purposes, and during swimming, when the body is submerged.

In the mammoth, however, there is relatively little space reserved for the trunk between the huge, closely set tusks. Correspondingly small are the chief points for its support about the nasal and premaxillary bones. Evidently the principal function of this organ was to pluck grass from the forest meadows. Perhaps the Aurignacian cave man of Combarelles, Dordogne, France, whose rudely sketched outlines of the huge beast showed a two-fingered tip to the trunk, may still earn his fame as an observing naturalist.

We might conclude from the very slight development of the trunk that, influenced by the boreal climate, the mammoth's temper was of a milder sort. It seems not to have been used as an instrument of fury to devastate, break, and tear whatever may have been in its way, as is the case with the well-developed trunk of its African cousin.

The ears were considerably smaller than those of the Indian elephant, measuring in the old Adams' bull only about fifteen inches in length and six and three-quarter inches across their greatest breadth. They were densely covered with short, woolly, and longer, bristly hairs.

The bony structure of the digits of the feet showed a pronounced tendency towards reduction. Some at least of these mammoths had already lost most of what in other mammals would correspond to the thumb and big toe and were four-toed (tetradactyl) and not, like living elephants, five-toed (pentadactyl). The random numbers of toe-nails of the Paris mammoth were ascribed by Neuville[9] to degeneration. Many of these supernumerary horny growths had striking resemblance to the normal nails, others were extraordinarily long and upturned, like those recorded from some menagerie elephants.

More decisive evidence of the mammoth's truly boreal habitus was furnished by its heavy, shaggy coat. It covered the entire body, but even where longest it did not form a distinctive mane. In general appearance and arrangement it resembled that of the musk-ox. The dense, matted, woolly underfur, varying from fawn to golden brown, attained according to location up to two inches in length. A longer, coarser, yet fluffy hair had an average length on

[9] 1919, L'Anthropologie, XXIX, p. 207.

the body of a foot and a half; in color it was deep rusty brown, sometimes darker, sometimes lighter, according to peculiarities of preservation; its texture somewhat resembled the fibers in the hard outer covering of cocoanuts. Outstanding from this were the scarcer, flattened, considerably longer, black, but flexible bristles that apparently were evenly distributed over much of the body. Particularly graced with them were such parts as the chin, eyelashes, and ears. On the tip of the short tail they formed a long, fan-shaped tassel, but even there were only one mm. thick. The trunk was well covered with dense, short hair. On fore and hind limbs the longer coarse hair had an average length of one foot two inches; at the lower portions it was considerably shorter.

As usual in mammals with dense underfur the epidermis in the mammoth was extremely thin and rather smooth, in that respect quite unlike the thick, horny, rugose, sparsely bristled skin of living tropical elephants. The leathery portion, however, according to various researches, proves to have been as thick as or thicker than that of present-day proboscideans. The histological character is essentially the same in both, neither of them possessing sudoriparous or sebaceous glands. Neuville suggests that the mammoth in evolving from ancestors living in a warmer climate and adapting itself to boreal conditions greatly reduced its epidermis.

No more important factor could be cited indicating the coldness of the climate in which the mammoth lived, than the abundance of fatty tissue just below the hide. On the belly of the Beresovka male this layer was three and a half inches thick. Fat of any kind is practically absent in recent elephants, as is usual in game of tropical Africa except the hippopotamus. Its presence positively shows that at the time of death the mammoths preserved as ice-mummies were not on the verge of starvation. What better protection against the oncoming rigors of winter could be imagined than such an accumulation of fat, common in many boreal land and aquatic mammals and always in those that hibernate.

Several lucky circumstances have contributed towards our fairly satisfactory knowledge about the feeding habits and food of mammoths. From what we know about living elephants the experienced can tell from a glance at the molars that the mammoth secured its livelihood essentially by grazing and not by browsing. Its cheek-teeth present a densely crowded condition of the component transverse plates with comparatively even, yet characteris-

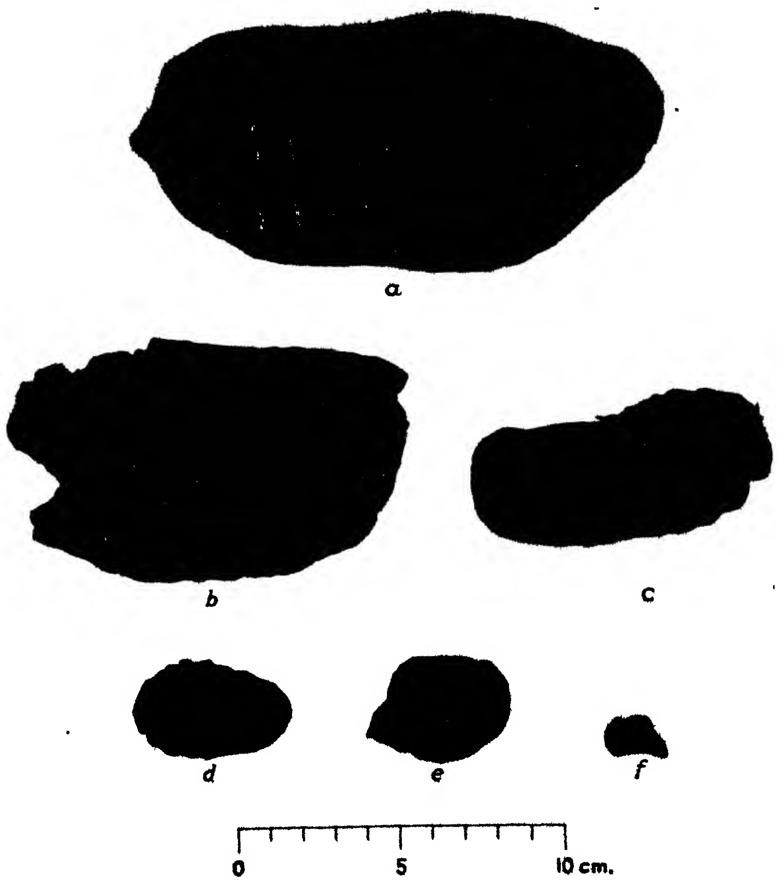

Fig. 16 Various stages in the development of upper and lower molars of the mammoth (*Elephas primigenius* Blumenbach). Anterior portion pointing toward left.

a. Third right lower molar at height of efficiency Enclosed within the high rims of enamel of each of the numerous transverse lamellae or their parts lies the softer and lower dentine The lamellae in turn are surrounded and united by cementum Anteriorly this molar is worn low

b. Second right upper molar Some of the anterior transverse lamellae have been shed, and the remaining ones are more worn than in Fig. *a*

c. Third right lower molar. Some of the posterior lamellae have not yet moved up from the jaw to the grinding surface.

d. Second left upper milk molar before piercing the gum. The individual transverse lamellae, still crested, have not yet been united by cementum.

e. Second left upper milk molar well worn, some of the transverse lamellae in front having been shed.

f. First left upper milk molar with a grinding surface of only 12 mm. This cheek-tooth belonged to a calf probably not more than a year old.

tically rough, crown surfaces. Their peculiarity and efficiency are greatly influenced by the singular action of food-stuffs under the pressure and friction of mastication. It is the amount of silicate, grit, and other hard materials contained in the food that causes an unequal rate of wear of the three principal substances composing these grinders. Under these circumstances the excessively hard enamel parts always remain as ridges, whereas the softer dentine and cementum form alternating depressions. The transverse plates of the cheek-teeth vary somewhat in complexity and number; from three in the first (milk molar) to as many as twenty-seven in the sixth or last molar. Osborn[10] has shown that Jefferson's mammoth (*E. jeffersoni*) of the American Pleistocene, from Indiana, may have as many as thirty in the upper molar and from twenty-four to twenty-six in the lower.

The masticating surface of the large, broadened molars* of the mammoth forms an efficacious milling apparatus for the grinding to pieces of the rather tough, but very nourishing, boreal meadow plants. A similar arrangement would not answer so well for the bulky, succulent masses of tropical vegetation on which the living Indian and African elephants subsist. The relatively compact nature of the fodder of the mammoth may have helped lessen the need for accommodating immense digestive organs and finally have led to a general reduction in size of the animal's body, back of the head, as mentioned above.

Borodin[11] was able to identify the plants found between the molars and in the stomach of the Beresovka mammoth. Above its ice mausoleum the flora of these Siberian forest meadows still showed essentially the same characteristics as thousands of years ago at the time of the victim's entombment. The average temperature may have then been responsible for a more uniform, milder climate, somewhat lacking the intense severity of present winters

[10] Osborn, Henry Fairfield, 1922, Amer Mus. Novitates No 41, pp. 1-16

[11] In Salensky, W., 1905, Compt. Rend Séan VI Congrès Internat. Zool., Genève, (1904), p. 72.

* The molars, as in other elephants, after emerging from the gum gradually move forward in the jaw. As the upper portion, the grinding surface, is worn down, the originally long, anteriormost roots are absorbed or "eaten up" within their sockets by special cells, the osteoclasts Thus only a flat, thin, center portion of the anterior part of the molars remains. As this is pushed out beyond the forward part of the socket the thin pieces of the composing plates break off easily, the worn ones being replaced by succeeding new ones from the rear. In this way the rather voluminous and heavy molars are easily accommodated in so limited a space and retain their efficiency till a relatively advanced age.

and allowing the forests to reach as far as about 74° North. The food gathered in abundance by the Beresovka mammoth just before death consisted of various kinds of grasses (*Alopecurus, Hordeum, Agrostis, Atropis,* and *Beckmannia*). Sedges were represented by two forms of *Carex.* A mint (*Thymus*), pods of a leguminous plant (*Oxytropis*), wild poppies (*Papaver*), and seeds of the northern butter daisy (*Ranunculus*) made up the list. Some pine needles and bits of wood figure as incidental occurrences.

From the above enumeration of characters it appears out of question, as formerly believed, that Indian elephants could be modified forms of the Siberian mammoth and had merely wandered southwards into the more luxuriant forests of tropical Asia, and in adapting themselves, had lost their heavy pelt and gradually changed otherwise. As shown above, the Siberian mammoth was in many ways too highly specialized to figure as an ancestor of the living Indian elephants, which must have evolved from some other form.[12]

As an argument against the boreal character of the mammoth there has been advanced the fact that in southern regions its remains were found mixed with those of such tropical types as the cave hyaena (*Crocuta crocuta spelaea*) and the cave lion (*Leo leo spelaea*), that actually had gnawed its bones. The Pleistocene European hippopotamus (*Hippopotamus major*) has been cited to the same purpose.

It is not so uncommon a feature among various groups of recent mammals to travel about in regions having relatively great differences in temperature and presenting a variety of environments. Our American bison once roamed from the plains of northern Mexico to the woodlands of Canada beyond Slave Lake. Another example is our puma, of which Theodore Roosevelt writes in his admirable account: "It is found from the cold, desolate plains of Patagonia to north of the Canadian line, and lives alike among the snow-clad peaks of the Andes and in the steaming forests of the Amazon." Another instance is offered by a race of white-footed mice (*Peromyscus*), whose footprints Dr. E. W. Nelson records having seen at 15,000 to 16,000 feet above sea-level on the volcanic ashes of Mt. Orizaba, Mexico. It thus furnishes the altitude record for North American mammals.

In Africa the browsing elephant (*Loxodonta africana*), with

[12] Osborn, Henry Fairfield, 1910, 'The Age of Mammals,' New York, p. 419.

its preferred haunts in denser wooded parklands, roams also over trackless swamps and enters arid desert stretches. The grazing buffalo (*Syncerus caffer radcliffei*) leaves the plains and invades forests, making itself at home even at 10,000 feet. Both on Mounts Kenya and Kilimanjaro records of the two visiting snow-fields and glaciers are at hand. More surprising still are the giraffe (*Giraffa camelopardalis tippelskirchi*), exploring the mountain forests of Kilimanjaro, and the eland (*Taurotragus oryx pattersonianus*), going even beyond to the mountain meadows. The lion in East Africa ascends from the lowlands to above 7,500 feet as in the Rift Valley and within the range of the mountain gorilla (*Gorilla beringeri*) on Mount Sabinyo,[18] reaching altitudes where the temperature during the night may drop below the freezing point. The lion has been bred with success freely exposed to the wintry rigor of the climate of Dublin. Leopard (*Panthera pardus suahelica*) and hyaena (*Crocuta crocuta germinans*), also typical animals of the lowland, go to over 9,000 feet on Mount Kenya. There, up to 15,000 feet, near the border of eternal snow, hyraxes (*Procavia mackinderi mackinderi*) too occur, differentiated only subspecifically from the lowland form. Colobus monkeys (*Colobus abyssinicus kikuyuensis*) are none the worse for icy-cold nights at 10,000 feet, though equally at home in the hot valleys far below. River-horses (*Hippopotamus amphibius*) even in captivity seem not to be so susceptible to cold as generally believed. In the zoological garden in London at least they were known to take their tubs in frosty weather.

Africa, with its very restricted mountain areas, gives no fair basis as to what happens in Asia with its more extensive ranges and mountain plateaus, or to what might have taken place in this respect during the glacial periods of the Pleistocene. Even among recent mammals the list could be increased considerably. One need merely mention the hardy, long-haired Manchurian tiger and the well-furred snow-leopard with firmly established haunts in colder climes though their closest relatives inhabit the tropics. The camel (*Camelus bactrianus*) and the yak (*Poephagus grunniens*), that survive the icy blasts of the Tibetan plateaus, show not the slightest effect in their welfare or reduction in breeding on descending into more temperate zones.

Certain it is that many of the high lands of the Pleistocene presented a wide, open expanse with an abundance of excellent

[18] Philipps, J. E. T., 1923, Geogr Journ. London, LXI, p. 247.

pasturage, as indicated by the large herds of gregarious mammals. There should be no surprise that some of the southern carnivores, like the lion, hyaena, and others, followed up such promising prey. Perhaps the borders of rivers in the summer offered also an abundance of choice fodder to the hippopotamus. All points considered, there is no reason why the hairy mammoth should not have wandered south. Its rambles may even have been undertaken during the colder season.

Being great nomads, like most of their relatives, the mammoths unquestionably wandered back and forth through most of the northern countries of Europe, Asia, and America. During the moist, cool climate of the third glaciation they made their first appearance in Western Europe, going as far west as the British Isles, at that time a peninsula, with the North Sea firm land; and even to Denmark and Scandinavia, where it was probably the remaining glaciers that stopped them at 62° North in Norway at Saejervaskter in Vaage; attaining, however, to 65° 30′ North in several places in Finland bordering the extreme north of the Gulf of Bothnia.[14] They also went southward to northern Spain and to Italy within the neighborhood of Rome. From northern Siberia they passed over to Alaska and America by way of Bering Strait or the Aleutian Islands before the separation of these continents took place, thence to California and across to North Carolina.[15] On the American continent their evolution progressed into still more gigantic forms as they reached evidently more inviting regions farther south.

Encouraged by slight fluctuations of temperature while glaciers were slowly advancing and retreating during the Pleistocene period the mammoths, like other mammals, shifted according to seasonal changes, either north or south, just as some of the African elephants nowadays accommodate themselves to dry and wet periods by traveling from the lower plateaus into the mountain forests and to escape from the annual grass-fires of the savanna into the safety of extensive swamp-lands. At the close of the glacial periods their haunts must have vitally changed. The mammoths apparently were not able to follow any more in the wake of the retreating ice and must have encountered conditions that sealed their fate.

Most interesting is the evidence of what the gigantic beasts

[14] Holst, Nils Olaf, 1913, L'Anthropologie, XXIV, pp. 363–364.

[15] Matthew, W. D., 1915, 'Mammoths and Mastodons,' Amer. Mus. Nat. Hist., No. 43, Guide Leaflet Series, p. 6.

must have meant to the cave-dweller of Europe. The Crô-Magnon men of France[16] were the first to leave for posterity authentic outlines of these monsters they had hunted. One of the finest examples is the sketch of a huge, shaggy tusker cut into a slab of mammoth ivory found in "La Madeleine" cave. This and other equally characteristic pictures, such as a curious little figure of the mammoth found at Predmost, furnish proof of the absorbing interest early Paleolithic man evinced in glorifying the enormous beast his heroes succeeded in overpowering. These early artists evidently wished to commemorate the bearer of so bountiful a supply of meat. They undoubtedly used parts of it as talismans, as in the case of a child's necklace of mammoth ivory beads found at Predmost.

In all probability the extinction of the mammoths was a gradual process and may have lasted hundreds of years or more. No single cataclysm, as Howorth[17] believed, could have been widespread enough to account for their abundant, mostly scattered remains throughout the Holarctic regions preserved, as they are, in such different ways. Besides innumerable traces in northeastern Siberia, the neighboring Polar Sea, and the American continent, great accumulations of their fossil bones occur also in certain places in Europe. Predmost in Moravia, where some eight hundred or nine hundred individuals were counted, is particularly famous, but the mammoth deposits near Cannstadt in Würtemberg and Hofstade in Belgium illustrate similar instances.

According to all authentic reports the mammoths preserved as ice-mummies, and found under various conditions of entombment, perished singly. Some of them were in prime condition, as young and fat individuals prove, and had plenty of fodder in their stomachs. These facts strongly favor the view that they met with accident, as instanced by the Beresovka and other finds. For this reason they have hardly any direct bearing on the real causes of extinction of their race that is to be set at a much later period. In a way they might be compared with the frozen body and a skeleton of the African buffalo found by Ross[18] and Mackinder, respectively, at about 14,000 feet on the glaciers of Mount Kenya. Wandering away from one of the many herds in the plains these rovers had perished on their unknown but curious excursion.

[16] Osborn, Henry Fairfield, 1921, 'Men of the Old Stone Age,' 3rd ed., New York, pp. 397–398, figs. 197–199.

[17] Howorth, Henry H., 1887, 'The Mammoth and the Flood,' London, p. xviii.

[18] Ross, W. McGregor, 1911, Journ. East Africa and Uganda Nat. Hist. Soc., II, p. 63.

It is significant that only the most gigantic mammals of this decidedly gregarious Pleistocene fauna have been transmitted to posterity in frozen condition. Their tremendous weight and relative clumsiness seem to have played an important rôle. Did they slip and fall, or were they precipitated to depths where cold would preserve them? Or were some of their bewildered troops devoid of the necessary agility and grit to extricate themselves from overwhelming storm and deep snowdrifts? Or did furious gales and blizzards cover them alive with icicles that quickly grew to encasing blocks of ice? As regards greater catastrophies, subsiding land-masses may have brought their doom, or inundations engulfed them. A few may have found their final resting places in swamps and bogs. Considering the various finds, certainly some and perhaps all of the contingencies enumerated contributed their share to the final extinction of the mammoth.

Every spring as a result of the setting in of warmer weather the important Siberian rivers move enormous masses of ice towards the Polar Sea. The clearing away of these obstructions is watched with intense excitement by the inhabitants of these ice-bound regions. A few months of river navigation means new freedom of traffic. They again can rove far and wide. It is then that hungry dogs may lead their masters to the masses of strongly smelling meat of the "mamonto" that has incidentally been uncovered along the thawing coves and banks.

Mighty are the struggles oncoming spring leads against the wintry forces. For a while great portions of these streams are dammed up by mountains of constantly shifting ice-floes. When these finally break through, parts of a new channel are often enough quickly ploughed up. After the generally sudden subsidence of these temporary floods, the old, abandoned stream bed freezes over again, imprisoning huge blocks of ice, debris, and all. Some of the water for a while held below the icy cover drains off and here and there large scattered pits are left between the chaotic masses. After years have leveled out these sites, ponderous beasts like mammoths wandering over such treacherous places might easily break through, be instantly killed, or become hopelessly mired. Later on erosive material piled over all may have formed the basis for the surface soil that practically furnished permanent protection. A few frozen bodies found in what was considered alluvial soil, mixed with pieces of ice, in a position as if ready to walk off, may have perished in this manner.

Fig. 17. The mounted mammoth unearthed in 1901 as an ice-mummy on the banks of the Beresovka River, northeastern Siberia, as it appears on exhibition in the Zoological Museum in Petrograd. The animal has been partly restored. Much of the real skin could be used in the mounting. Some of the hair has been replaced.

The cramped position, broken bones, large amount of clotted blood in the body cavity, as observed in the Beresovka mammoth, point, as Salensky shows, towards instantaneous death by accident. The victim did not even have time to throw out or swallow the quantities of fodder between its molars and in process of mastication. Salensky gives a cause for such a tragedy. During extremely rigorous winters the formation of wide fissures in the ground is not rare in northeastern Siberia. With the oncoming warmer season these clefts rapidly fill with water which may cause extensive subterranean washouts. Later some colder spells may cover such basins with a sheet of ice, below which the percolation of the remaining water continues in other directions, thus giving rise to what really amounts to an underground cave. Subsequent strengthening of the surface ice and final covering with humus, until level again, would form a sufficiently strong cover for everything except the weight of so colossal a beast as the mammoth or rhinoceros. Late in summer such places might be specially weakened and the unfortunate animal crashing through into the cavities would be instantly imbedded in the masses of ice and frozen debris loosened by the accident. Severe storms and periods of intensive freezing that usher in winter would soon remove all traces of the entombed. For thousands of years the victim might never be moved, except through the infinitely slow processes of floods and similar erosive actions.

Without question all those mammoths discovered frozen in practically fresh condition were at the very moment of their destruction surrounded by a temperature that completely excluded decomposition. The perpetually frozen ground of northern Siberia acted much like a modern refrigerator. For periods variously estimated at anywhere from 12,000 to 25,000 years, such ice-mummies may have reposed far below the protecting mantle of tundra vegetation. Here, as in the vast expanses of the "taiga," the swampy Siberian forests, they were, so to speak, permanently protected, the ground being frozen generally at three feet below the surface even during the hottest of summers. That great numbers of these and other mammals perished without being preserved in such perfect fashion is sure. In some places the earth and the shores of certain islands along the Polar Sea were literally crammed with their bones. The solid clay of higher sites inland preserved them pretty well, but elsewhere climatic conditions

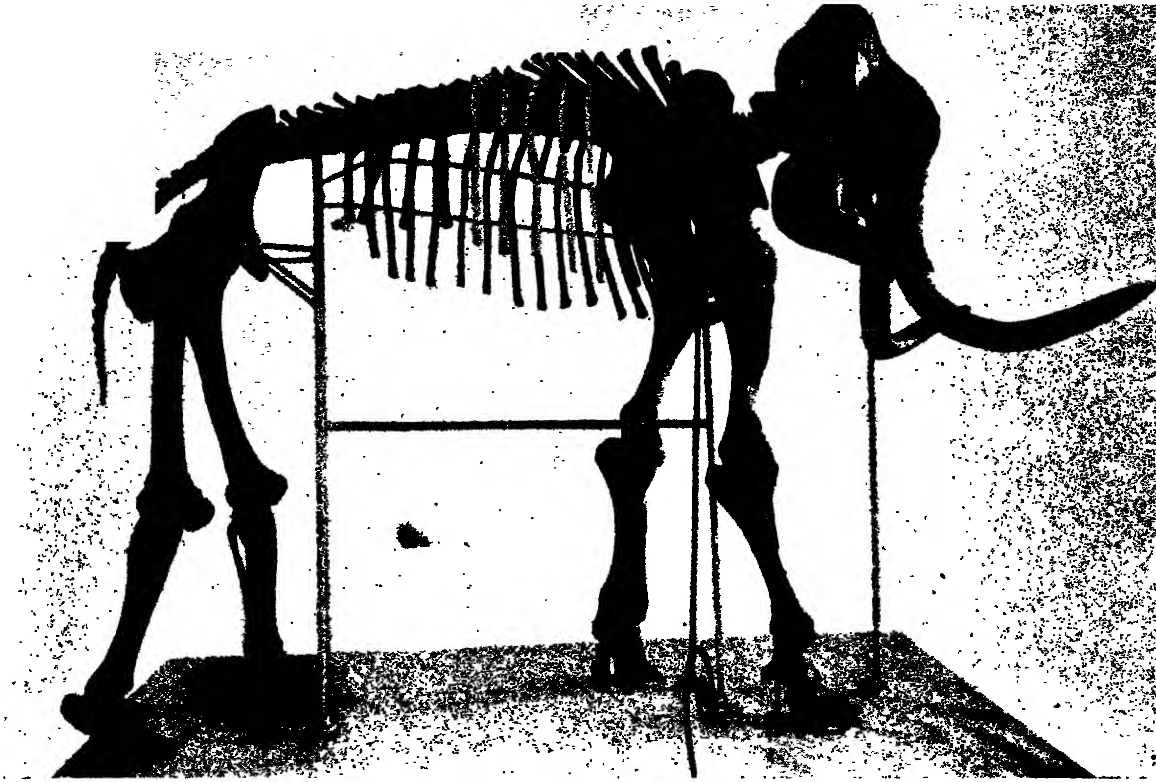

Fig. 18. The Beresovka mammoth skeleton as mounted in the Petrograd Museum. One tusk and several ribs had to be replaced To the top of the head the animal's height is given as ten feet nine inches.

fostered the more rapid decay of others, or without doubt there would be many more.

Mammoth tusks have for many reasons aroused considerable interest. To the scientist they are the permanently growing second pair of upper incisors, composed mainly of a solid but peculiar dentine, the "ivory" of commerce. To the poor Siberian hunter, with his pick and ax ready to chop into pieces whatever tusks he can discover on his migrations in the wilderness, they are "white gold." To the Chinese artist the delicate, fine texture and peculiar pallor of the easily carved substance brings new incentive for his varied talents.

Strongest is the claim of the superstitious. Small parts of mammoth ivory have meant to him the chance of his life. They have served even as relics of Christian saints. We are told that devout prayers addressed to them have given earnestly hoped for succor and success. Heathen with still stronger beliefs deeply implanted in their hearts as regards the occult powers of this marvelous substance have had their satisfaction too. Equally many-sided were the supposed medicinal virtues of mere scrapings. The Chinese have been more beguiled by them than by their "dragon bones." And western Europe did not free itself so very long ago from faith in such wonder cures. With their application, hemorrhages, ulcers, broken bones, epilepsy, fevers, plague, and cholera[19] would all vanish, according to the fancy of many. For that very reason they furnished princely revenues. As many as sixty tusks from the fossil mammoth deposits at Cannstadt were sent to the pharmacy of the Court, and became the precious powder of the "Licorne."

Gross credulity has been carried even into other channels. What of the warrior whose sword hilt, carved of mammoth ivory, is worth more to him than one wrought of gold or silver?

In the matter of art Siberia itself has made little use of its great supply of ivory. Only a few figurines, animals, characteristic scenes of the native land, often in heavy relief or bold freedom, combs, vases, and boxes, are made in certain centers. Export of the crude tusks after all has been the mainspring of their efforts.

A great impulse to the exploitation of Siberian mammoth ivory along the edge of the Polar Sea, its cliffs, and islands near the mouth

[19] Kunz, George F., 1916, 'Ivory and the Elephant,' p 239.

of the Lena, was given when Catherine II, Empress of Russia, took a personal interest in the matter. In October 1771 she wrote to Voltaire[20]: "But what proves, I think, that the world is a little older than our nurses tell us are the finds of bones of elephants long ago extinct in these regions and imbedded several fathoms below the surface of the ground in northern Siberia. Scientists . . . have said that it is fossil ivory, but, how is it possible? fossils do not grow in the form of very complete elephants."

Some time before, she had given orders to investigate the archipelago later known as the "New Siberia Islands," whose highest point attains 1,200 feet. The southern two, low, and completely uninhabited Liakhoff Islands were named in honor of the fur merchant who, following the tracks of an enormous herd of reindeer coming from the north, discovered what later proved to be inexhaustible mines of mammoth ivory. The Czarina also had conferred on Liakhoff the exclusive right to hunt and to collect ivory on them.

Many huge tusks were partly sticking out of the sand and others, together with bones, were constantly swept up on the shores by the waves. To what depth do these marvelous deposits cover the sea-bottom no one seems to know. Did these vast stores of wealth come from further inland, and were they carried out to sea with the crushing masses of ice in the spring? Here and there a frozen mammoth might have been moved thus along when whole sections of the partly thawed up river banks were undermined or torn out. Or did countless numbers of these huge beasts make their last desperate stand in these regions before the land was swallowed up by the sea?

Evidence for subsidence of land masses is more certain, as apparently much of this expanse once formed part of the Asiatic mainland. On some of these islands Silurian coral and Devonian limestone, volcanic rocks, indicate that uplifts, as might be expected, had a part in the present physiographic configuration. On the northernmost, Hedenström found Tertiary strata with fossil bituminous tree trunks in horizontal and upright positions, over 200 feet above sea-level. Other rich deposits of the same age with their interesting fauna and flora indicate a climate once very much warmer. But some of the lower islands off the coast show a few peculiar granite boulders and are covered with a deep mantle of drift formed chiefly

[20] Boule, M., 1917, L'Anthropologie, XXVIII, p. 187.

of sand, and buried ice in separate layers and incongruous blocks. These deposits were particularly rich in ivory tusks and masses of mammoth bones. Associated with them were the remains of other of the northern Pleistocene mammals, such as the woolly rhinoceros (*Coelodonta antiquitatis*), Siberian bison (*Bison priscus*), wild horse (*Equus caballus fossilis*), moose (*Alces latifrons*), reindeer (*Rangifer tarandus*), and musk-ox (*Ovibos fossilis*).

Unquestionably the mammoth was boreal in habits and most abundant in the colder regions. In northern Siberia, it flourished in all the territories between the Ural Mountains, Obi, Yenisei, Lena, Indigirka, and Kolyma, and particularly in the adjacent islands of the Polar Sea. These, therefore, with their fabulous stores of ivory, are the greatest graveyard of mammoths known. Von Wrangell described some parts of this region as containing hecatombs of such remains before they were ransacked by those in search of the valuable tusks. Should we wonder that for over a hundred years organized ivory collecting flourished without any apparent diminution of the supply?

The rigor of the climate imposed by far the greatest drawback to this greedy quest. At Liakhoff Island the open season lasts really but a few months. Bunge[21] in 1882–1884 records 90° F. below freezing point in winter, with snow falling half through July. But even under such trying circumstances enormous quantities of ivory have been removed. In 1821 one trader alone sent off 20,000 lbs. Middendorff in 1841 estimated the annual output for the preceding twenty years as at least a hundred pairs of tusks. In 1881 Nordenskiöld,[22] basing his opinion partly upon the amounts still shipped, considered this figure as rather too low than too high. He arrived at the conclusion that since the conquest of Siberia select tusks from 20,000 mammoths had probably reached the markets of the world.

From Westendarp we know that the fairly well stabilized imports to Europe of fossil ivory in 1872—with London then the chief market—amounted to 1,635 mammoth tusks or about 245,250 lbs., granting an average weight of 150 lbs. apiece. The proportion of well preserved ivory among such lots is surprisingly small—only 14 per cent; and a slightly larger amount, 15 per cent, is absolutely

[21] Bunge, 1893, Congrès Internat Zool, Moscou, Session II, (1892), pt. 2, p. 282

[22] Nordenskiöld, A. E., 1881, 'The Voyage of the Vega around Asia and Europe,' London, I, p 404, footnote.

useless. But even the really "bad," amounting to 54 per cent, and the "still workable," 17 per cent, when treated properly and fashioned into the plainer objects passed in the trade.

For the most part these could not have been tusks of mammoths entombed in ice, the ivory of which compares well with that of recently killed elephants, but evidently had been subject to various disintegrating influences. So great was the demand for this remunerative article that in Europe mammoth tusks of far inferior quality to the Siberian product were formerly dredged in quantities from the Doggerbank by the North Sea trawlers.

In rare cases mammoth ivory is slowly impregnated with certain metallic salts and then known as odontolite or blue ivory. Used for jewelry it is highly prized for the delicate, yet vivid, blue, turquoise-like luster. The Eskimos of Alaska, according to Gilmore, are fond of a blue dye they secure from the phosphate of lime (vivianite) formed by the decomposition of mammoth tusks.

Many hundreds of thousands of these enormous tusks must have completely decayed. What great herds of shaggy mammoths may have roamed during Pleistocene times in the proximity of the circumpolar area can be deduced from Darwin's computations[23] about the possible increase of the recent elephant, considered the slowest breeder of known animals. If, at a minimum rate of natural increase, between the ages of thirty and ninety years, only three pairs of young be raised, he comes to the conclusion that "at the end of the fifth century there would be alive fifteen million elephants, descended from the first pair."

The Pleistocene mammoths during several hundred thousands of years had totally adapted themselves to a life in a monotonous, frigid zone. Uniformity indeed is the hall-mark of boreal regions as much as diversity is that of the tropics. During so long a period they gradually became highly specialized, long-lived monsters. Being excessively slow breeders they entered a stage where further evolution or even slight adaptive changes were reduced to a minimum. This meant the death warrant of their race. Perhaps in the boreal climate the balance of endocrine functions had long before been disturbed so that undesirable specialization went on unchecked and possibilities of forming varieties of greater vitality were practically eliminated. But whatever the causes of their final

[23] Darwin, Charles. 1860, 'On the Origin of Species,' 2nd ed., p 63.

extinction, here, at least, nature has preserved from the enormous numbers of these shaggy monsters a few victims of individual accidents as ice-mummies. They have now become a unique source of information. Still others rest in frozen Siberian ground waiting to disclose more secrets of bygone ages.

Zoologica Vol IV, No

THE GALAPAGOS TORTOISES
IN THEIR RELATION TO THE WHALING INDUSTRY
A STUDY OF OLD LOGBOOKS

By Charles Haskins Townsend
Director of the New York Aquarium

(Figs. 20–32 incl.)

The Galapagos Islands were appropriately named the isles of the tortoises. From the time of their discovery by the Spaniards early in the sixteenth century, down to the middle of the nineteenth century, their outstanding feature was the presence of great numbers of land tortoises of gigantic size. No other product of the lonely archipelago was of more than passing interest to navigators except the fur seals, which they soon disposed of. Most of them however noted the fearlessness of the birds on these uninhabited islands and the strange behavior of the hitherto unknown marine iguanas that lived on seaweed.

The early navigators quickly discovered the high edible value of the big, hard-shelled "galapagos" which they described in extravagant terms. All mariners adventuring that way during the seventeenth and eighteenth centuries loaded their decks with tortoises and proclaimed their excellence in all seas where ships sailed.

Then came the fleets of whalers of the nineteenth century, British and American, to gather the rich cetacean harvest of the Pacific. The abundant and long-celebrated tortoises of the islands offered a fresh food supply of which they hastened to avail themselves. A measure of their levies upon the wild pastures of these great reptiles has been brought to light recently through examination of some of their logbook records. It appears that they carried away many thousands during a period of more than a half a century, the closing years of which marked both the diminution of the supply of tortoises and the decline of the whaling industry. While navigators of all kinds—the early explorers, the buccaneers, the sealers, and

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[1] For facilities in consulting logbooks of whaling vessels, the writer is indebted to Mr George H. Tripp, Director of the Public Library, New Bedford, Mass , Mr A C Watson, Assistant Curator, Museum of the Old Dartmouth Historical Society, New Bedford, Prof. Edward S. Morse, Director and Mr L W Jenkins, Assistant Director, Peabody Museum, Salem, Mass , the Librarian of the Essex Institute at Salem and the Librarian of the Historical Association at Nantucket, Mass Mr Watson rendered especially valuable service in copying records relative to tortoises from many of the logbooks preserved at New Bedford and Nantucket.

The examination of the logbooks was made under the auspices of the Zoological Society.

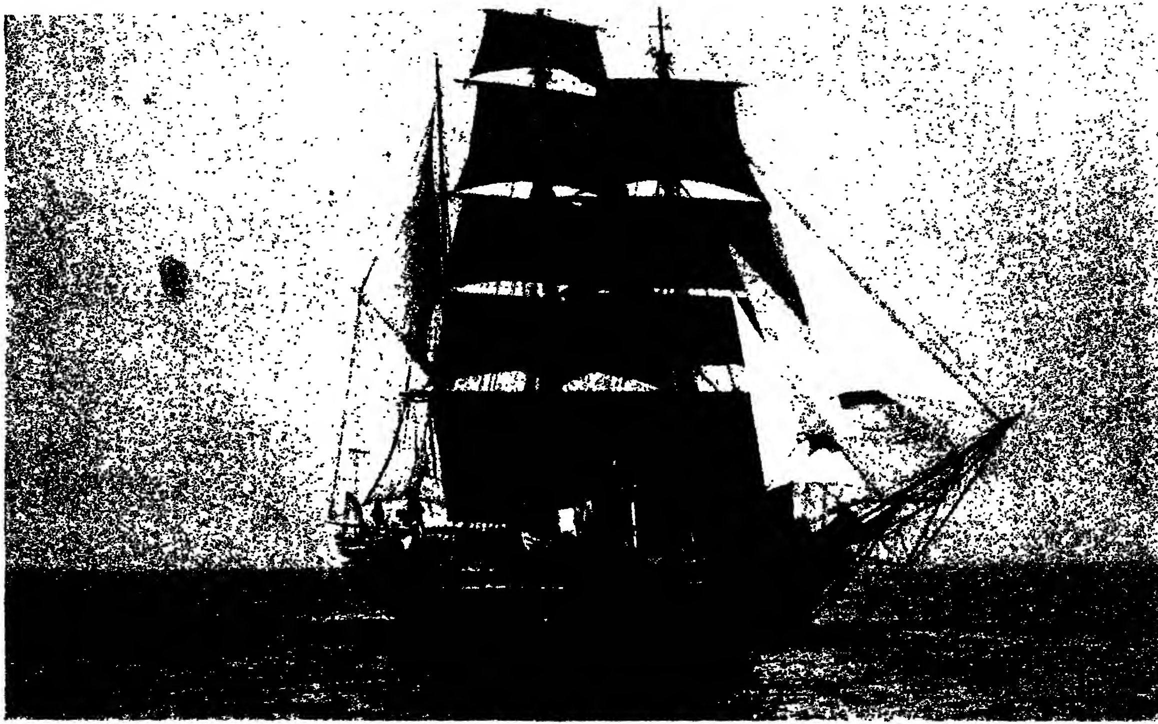


Fig. 20. Bark *Morning Star* of New Bedford. At Albemarle Island, Galapagos, July 27 to August 5, 1858. At Chatham Island, Galapagos from June 27 to July 11, 1861. Total catch of tortoises, 212. Built at Dartmouth in 1853. 305 tons. Returned from last voyage in 1914. Crew on first voyage all Americans, on last voyage all Portuguese. Photograph by W. H. Tripp, 1914.

the passing merchantmen, carried away as many tortoises as they had space for, the whalemen made heavier demands upon the supply than any of the others. No other class of sailormen was ever so numerous in eastern Pacific waters.

While in service at the Court of Arbitration at The Hague in 1902, the late Captain George Baker of New Bedford, a veteran whaleman, was associated with the writer, and learning that he had visited the Galapagos imparted much information relative to tortoise hunting by whalemen among those islands. With these interviews in mind, it seemed probable that the logbooks of whaling vessels, if available, would yield new information on these nearly extinct animals, and a search was accordingly made for them, which was crowned with a fair measure of success.

We have now at hand records from the logbooks of seventy-nine whaling vessels[2] that made one hundred and eighty-nine visits to the Galapagos between 1831 and 1868 for the purpose of securing tortoises. Their combined catch during this period was 13,013. The study of a larger collection of logs would undoubtedly yield more information of statistical value, but the records already available afford a safe measure by which to gauge the effect produced by the fleet as a whole. In view of the facts that there were more than seven hundred vessels in the American whaling fleet at one time, and that the majority of these made repeated voyages to the Pacific during the above mentioned period called the golden age of whaling, it is evident that the catch here recorded was a mere fraction of the numbers of tortoises actually carried away.

It is also evident and much to be regretted, that hundreds of old whaleship logbooks have failed to make a home port in some historical library with other sea-wanderers of their kind. The attics of old whalemen's homes doubtless contain many of them, which it is hoped, may eventually be brought together. We have as yet examined only those preserved in the libraries of New Bedford, Nantucket and Salem. These are of course the logs of American vessels only. What tortoise history lies concealed in those of vessels belonging to Great Britain and other countries formerly engaged in whaling in eastern Pacific waters can only be conjectured. British whalers disappeared from this region during the war of 1812 and the American fleet was greatly reduced. Many vessels

[2] See lists of vessels, pp. 77–82 and Appendix, pp. 103–135.

were captured on both sides. None of the logbooks at hand is of earlier date than 1831, although vessels of both countries were whaling about the Galapagos during preceding decades.

The extracts from the logs supply data respecting tortoises that have hitherto been lacking, giving not only the dates and the separate islands visited but in most cases the numbers of tortoises secured at each. As each island of this anomalous archipelago bore its own particular species of tortoise,[3] the most of which are now extinct, the logbooks of the whalers furnish considerable information respecting the progress of the work of extermination. They contain also information as to the methods practised in collecting and transporting tortoises.

The numbers of tortoises taken by some vessels cannot always be given in full. There are occasional log entries giving the catch by "boat loads," and these being difficult to estimate, are ignored in our summing up. In the list of vessels with catches recorded definitely, there are eight with log entries mentioning additional "boat loads." The ship *Phoenix* at James Island on July 20, 1835, makes record of twelve tortoises brought on board, and from the 25th to 28th, seven "boat loads" more. This being in 1835 when tortoises were abundant enough to permit selection of such convenient sizes for carrying as fifty to seventy-five pounds, a "boat load" might have consisted of twenty or more tortoises of such sizes. Allowing this particular vessel merely the average known catch per vessel during that decade, her supply of tortoises from James Island was not less than eighty-six. Doubtless the number was much larger. The whale-boat, twenty to thirty feet in length, has a large carrying capacity. According to the log of the bark *Morning Star* at Chatham Island on July 10, 1861, "all three boats came on board each one brought 20 Turpin." Captain Barnard's narrative of the ship *Millwood* says "Mr. Coles had forty-five terrapin in the boat," which indicates a still greater carrying capacity.

The number of tortoises actually taken by the vessels on our list was therefore considerably greater than the total given above.

The logbooks of some vessels record the presence of other whaleships among the islands, seeking tortoises, many of them with

[3] Naturalists are not in accord as to the validity of some of these so-called species. A few of the islands have been inhabited at times since 1832 and all have been visited by vessels to such an extent that more or less transportion of tortoises among the islands could not have failed to take place. Specific names have been bestowed upon immature specimens which are different in appearance from very old ones, while the localities from which some museum specimens were derived are uncertain.

names not found in the present list. Were the scrawled and stained records of all available, there would be many more tales of arduous hunting of tortoises in the sun-baked, cactus- and thorn-filled gullies of the islands. The log of the ship *Hector* of New Bedford, at Albemarle on November 2, 1841, has this entry: "boats returned with 10 Terrapin, Rodman [another whaleship] about the same, . . . at daylight 7 ships in sight." The log of the ship *Barclay* contains this entry under date of August 11, 1835: "Narborough bore S.E. distant 25 miles, saw 9 ships cruising." In the log of the bark *Henry N. Crapo*, at Barrington Island on April 12, 1853, we find the names of six other whaleships that were in sight at the time. The log of the ship *Congaree*, at Chatham Island on July 6, 1847, has the following record: "3 boats started for Terrapin, saw 3 ships at anchor at Terrapin Road." Since the seventy-nine vessels whose logs constitute the basis of this study, averaged more than two visits each to the Galapagos for the purpose of securing tortoises, we may assume that it was the practise of all vessels cruising for sperm whales in the eastern Pacific to do so. It was in fact a rendezvous for the fleet. In 1852 three whaleships were lost among these islands.

"Turpining" as the whalemen called it, was therefore the attraction that accounted for their presence at the Galapagos. Some of them got wood for fuel and a very few found fresh water, but all sought tortoises. They relied on them for fresh food and made special preparations for collecting them. In the log of the bark *Atkins Adams* at Chatham Island on July 5, 1861, there is a record which reads, "Employed in geting straps ready to fetch tearpin with." Another log says "All hands employed in making belts to go after terpen."

Tortoise hunters were sent ashore by the boat load. The log of the *Edward Carey* at Albemarle on November 9, 1862, in company with three other vessels, contains this record: "Each ship have sent one boat with nine men apeace after terrapin." Tortoises weighing from fifty to seventy-five pounds were the sizes most readily transported. A tortoise to a man was the usual load, the carrying of which was called "backing them down." Sometimes men were sent ashore with provisions for several days' work. The log of the ship *Pocahontas* at Chatham Island on August 30, 1861, says "sent two boats ashore with provisions and water for 3 days."

Fig 21 A Galapagos Tortoise (*Testudo ephippium*), on the U S S *Albatross* Found on Duncan Island in 1891 by C H Townsend Now in the U S National Museum Photograph by C H Townsend

Tortoises too large to be moved were frequently killed and the meat carried on board for immediate use, while others were turned on their backs and dragged by means of ropes tied to their legs. The latter method of transportation was, however, practicable only on favorable ground and for short distances. Large tortoises were also slung to oars to be carried by two or more men when the distance was not great.

It was unquestionably hard going for the tortoise hunters over the broken volcanic waves that are called land in the Galapagos, even for able-bodied seamen accustomed to long tugging at the oars of whaleboats: One tortoise hunter says "we got about 250 altogether which cost us much trouble." Another writes in his log: "at 8 P.M. on board tired oute," and another, "returned with five Terrapin and intirely exhoisted."

The writer, who has tried tortoise hunting, finds it easy to sympathize with them.

Ships visited the islands at all seasons of the year. A successful catch at one season on an island where tortoises were plentiful could not always be duplicated a few months later the tortoises having moved into higher country in search of water. In the larger islands water is usually to be found in the elevated interior regions when totally lacking at lower coastal levels but the tortoises apparently occupied lower country as long as water was there available.

It was to the lower country, chiefly, that female tortoises resorted to dig holes for their eggs; a habit contributing greatly to their decimation, as this region was most exposed to the raids of the hunters. The medium sized animals were the ones most sought for convenient transportation and these happened to be the females. Darwin says: "the old males are the largest, the females rarely growing to so great a size." Porter writes that of the "fourteen tons" of tortoises taken aboard his ship at one time in 1812 "only three were males."

These records throw light on the fact that the tortoises obtained by scientific expeditions later on, were largely males.

Travel is exceedingly difficult in all islands of the group and whalers seldom attempted to penetrate far inland. Otherwise the supply of tortoises could hardly have lasted as it did throughout the long period of whaling activity. It was no uncommon experience for seamen to get lost and remain ashore over night, while in some

Fig 22 Skeleton of Duncan Island tortoise (*Testudo ephippium*) as mounted in the U S National Museum Collected in 1891 by C H Townsend

instances lost men were finally abandoned to their fate. The following melancholy record is from the log of the ship *Chili* at Albemarle Island in 1841: "Sept. 25, 6 P.M. two boats came with 22 [tortoises] lost a man, . . . daylight Sept. 26 sent all hands to look for lost man." "Sept. 27, could not find him, left bread and water and directions in a bottle if anyone should ever find him." Occasionally a lost Crusoe, if he had succeeded in finding water, was picked up by another vessel after weeks of solitude.

According to the records at hand, tortoises were taken from nine of the islands of this group: Chatham, Albemarle, Charles, Hood, James, Abingdon, Duncan, Indefatigable and Barrington. Fifteen[4] species of tortoises have been described from these and the small island of Jervis, five being from the large island of Albemarle. The smaller and lower islands were the first to be stripped of their stocks of tortoises but scattered numbers existed on some of them for many years after the whalers vanished.

Albemarle, the largest of the islands, has a length of seventy-two miles, an average width in its northern part of ten miles and in its southern part of twenty miles. Its greater elevations have heights varying from 3700 to 5000 feet. Indefatigable, the next in size and rather rounded in outline, has a diameter of about twenty miles. Its central elevation is 2296 feet. Narborough, third in size and also somewhat rounded in outline, has a diameter of about fifteen miles. Its volcano is 4300 feet high. Chatham measures nearly twenty-four miles in length by eight in width. Its greatest height is 2500 feet. James is also one of the larger islands having a length of twenty miles and an average width of ten miles. Its elevations are from 1000 to 2700 feet. All of the remaining islands which bore tortoises are of much smaller size than the preceding, but most of them have elevations exceeding 1000 feet. All islands of the group are on or near the Equator.

From Charles Island which was inhabited by a large colony of Ecquadorians during the "thirties," the tortoises practically disappeared during that decade. Darwin who visited Charles Island in the *Beagle* in 1835 stated that the main article of animal food of the settlers was derived from the tortoise. According to the log-book records now before us, the ship *Aurora* "got a few Turrapin" from Charles Island in 1848, but these must have been purchased as the inhabitants were already drawing supplies of tortoises from other islands.

[4] The late Doctor Van Denburg's List of Species

The last record for James Island is that of the bark *Alfred Tyler*, in 1845, which took twelve tortoises on October 11. The ship *Good Return* of New Bedford with four boats' crews ashore in 1848, "could not find any."

The very small island of Barrington saw almost the last of its tortoises in 1839, when the ship *George and Susan* of New Bedford took twenty-two on December 21 and 22. The bark *Henry N. Crapo* of South Dartmouth, visited Barrington on April 22, 1853 but found only one tortoise.

Hood Island, which is somewhat smaller than Charles Island, yielded 1698 tortoises to the vessels in our list, the last, seven in number, being taken on September 26, 1853 by the ship *Congaree* of New Bedford.

There are logbook records for Chatham, a large island, as late as 1863, for Abingdon in 1867, and for Duncan in 1863. During the fifties and sixties five vessels obtained a total of only sixteen tortoises on Abingdon while Duncan one of the smallest, yielded 356 during the same period. It is a singular fact that tortoises survived in small numbers on Duncan Island long after they had practically disappeared from Charles, James, Hood, Chatham and Abingdon, all much larger islands. One specimen only was found there by the Williams Expedition in 1923, none having been seen elsewhere.

Chatham Island was seldom visited by whaleships until 1837 when the ship *Omega* took two hundred and forty tortoises in nine days. In 1861 five vessels secured there an average of only eighty-seven tortoises in nine days' average work. During the period covered by our records, 1831 to 1868, this island yielded nearly twice as many tortoises as Albemarle, next in point of catch by whalers. Chatham was not colonized until 1855, a condition favorable to its tortoise life as compared with Charles Island, colonized in 1832.

For Indefatigable, one of the large islands (named after a British frigate in 1816) the catch by whaling vessels is surprisingly small, although Beck reported them as "not rare" in 1906. The total taken there by whalers from 1833 to 1848—the last, was three hundred and sixty-six. Albemarle, largest of the islands, rugged and mountainous, continued to yield tortoises to energetic hunters long after they had become scarce elsewhere.

While the Galapagos Islands undoubtedly furnished large sup-

plies of tortoises to passing vessels during the greater part of three centuries, the estimates of the numbers carried away seem, in view of the figures contained in our logbook records, to need revision. Doctor Bauer who visited the Galapagos in 1891 thought that ten millions of tortoises might have been taken from the islands since their discovery. Reynolds estimated the tortoise catch of thirty-one whaling vessels at Charles Island in 1832 and 1833 at 200 each. This average may be too high. Our records for the thirties show that the average catch at Charles Island by nine vessels during that decade was 138. The average per vessel for the Galapagos dwindled to sixty-two for the three following decades.

There is no evidence that tortoises were ever found on Culpepper, Wenman, Bindloe or Tower Islands and the logs of the whalers contain no references to them. The first two are little more than rocks. The ship *Good Return* of New Bedford anchored at Tower Island—possibly in the large bay—on December 27, 1848 and "lowered all four boats--went ashore after terrapin—could not find any." The ship *Gay Head* of New Bedford sent boats ashore at Tower Island on February 17, 1853, which according to the log, returned with "not very flattering accounts as regards Terrapin."

Their absence from a low island such as Tower is doubtless due to lack of water. This island two miles in length, has an elevation of only 211 feet, while Duncan, still smaller has an elevation of 1300 feet. Other small islands that bore tortoises were all much higher than Tower, Abingdon having an elevation of 1950 feet, Barrington of 900 feet and Jervis, smaller than any of these, a height of 1050 feet. All of the tortoise-bearing islands are known to have water in their higher sections during all or part of the year.

The ship *Zenas Coffin* of Nantucket visited Jervis, the smallest of the tortoise-bearing islands, on July 12, 1850, and "sent in two boats to find terrapins but did not see any." This is the only reference to Jervis Island found in the whole series of logbooks. There are single specimens of the Jervis Island Tortoise (*Testudo wallacei*) in the Rothschild museum and the California Academy of Sciences, apparently the only specimens in existence of this extinct species. The tortoises taken on Crossman and Cowley, small islets close to Albemarle, are included in the catch made on that island.

Narborough, third in size among the islands, is not mentioned in the logbooks in connection with tortoise hunting, although there

are references to the behavior of the volcano on that island. R. H. Beck in 1906, after a prolonged search, found an old male tortoise on Narborough, the only one apparently ever recorded. It was later described as a new species (*Testudo phantastica*). It is not improbable that tortoises were largely destroyed on that island from time to time by lava flows and by intense heat. In Morrell's[5] graphic account of an eruption of the Narborough volcano in 1825, he records the temperature of the air where his ship lay becalmed and in great danger, at 147° and of the sea water 150°; temperatures sufficiently high to destroy all animal life about that part of the island.

The log of the bark *Equator* of New Bedford, Thomas H. Mathews, Master, at the Galapagos in 1846, contains the following, relative to the volcano on Narborough Island, which is of interest as a record of volcanic activity for that year: Nov. 6. "Saw a volcano on Narborough Island, east side, in full operation. A river of lava running down to the water at Christopher's Point, bearing S.E. distant 12 miles. The volcano seems to be a split some half-mile in length and is continually sending up a high flame and lava which runs down a space of three miles into the water. We are about 15 miles from it and can see it very plain." Nov. 24. "Being up in Weather Bay, well over on Narborough side, the volcano is in awful operation at present. There is one large cone which is like a large boiling pot which is boiling over. The red lava covers a field of 5 or 6 miles, which is a great illumination in the night." The Narborough volcano as seen by us in 1888 from the U.S.S. *Albatross* was apparently emitting smoke but was not otherwise in activity.

In making some of the larger catches of tortoises during the thirties, vessels spent from five to nine days at an island. The following named vessels each took two hundred or more from 1831 to 1837:

Ship	*Isabella*	Hood	Island	1831	335	tortoises	5 days
"	*Hesper*	"	"	"	250	"	6 "
"	*Hector*	Charles	"	1832	226	"	7 "
"	*Moss*	"	"	1834	350	"	9 "
"	*Loper*	Hood	"	"	237	"	6 "
"	*Lima*	James	"	1837	224	"	7 "
"	*Omega*	Chatham	"	"	240	"	9 "

These large catches make a total of 1962 tortoises taken in an average of seven days.

[5] "A Narrative of Four Voyages," By Benjamin Morrell, New York, 1832.

The best catches made during the 'sixties by a similar number of vessels, averaged less than half of those made during the 'thirties varying from sixty-three to one hundred eighty-eight, while the time in securing tortoises was from five to fifteen days:

Bark	*Ohio*	Albemarle Island	1860	81	tortoises	5	days
"	*Ospray*	" "	"	122	"	10	"
"	*Morning Star*	Chatham "	1861	188	"	15	"
"	*Atkins Adams*	" "	"	105	"	13	"
Ship	*Edward Carey*	Albemarle "	1862	95	"	7	"
"	*Roscoe*	" "	"	63	"	7	"
"	*Edward Carey*	Duncan "	1863	130[6]	"	7	"

These vessels took only 693 tortoises in an average hunting time of nine days.

There were other agencies besides food-seeking ships at work affecting the tortoises. The settlements of Ecuadorians on Charles Island and later on Chatham and Albemarle islands, used them not only for food but for their oil, which was sold to whalers for culinary purposes or sent to markets on the mainland. Large numbers of tortoises were regularly killed for their fat alone. In the settlements tortoises were kept for sale to whalers and there were a few small Ecuadorian vessels that gathered them for the same purpose. The log of the ship *Robert Edwards* at Chatham Island on December 24, 1843 contains the following: "At 9 P.M. the boats all came off and brought the remainder of their Terrapin makeing 190 in all and 72 that the Captain bought." The log of the ship *Edward Carey*, at Indefatigable Island on December 28, 1863, has this entry: "At 10 A.M. a small schooner Anchored close to us the Captain went on board bought of them 78 Terripan."

The log of the ship *George and Susan*, off Charles Island on August 30, 1855, contains this record: "Spoke a brig from the coast that wanted to sell Terrapin."

The domestic animals—dogs, cats and pigs, becoming wild and increasing in numbers, proved destructive to the eggs and newly hatched young of the tortoises. At the present time, wild dogs

[6] Not including those purchased from a small trading schooner.

probably constitute the greatest danger to which the small remnant of tortoises in the mountains of Albemarle is exposed. Beck in 1906 found the native oil makers still at work in the high interior of Albemarle and dogs were both numerous and destructive.

In the various searches that have been made for tortoises during the past thirty years by scientific expeditions, islands have been stripped of all that could readily be found and the belief expressed that few remained, yet later expeditions managed to pick up stragglers. The explanation is probably that where dogs are not found, the very young are easily overlooked, but after a few years became large enough to be detected. These volcanic islands are so rough and brushy, so gashed with deep cactus-filled gullies, that the small tortoises that have escaped rats, cats, dogs and pigs in infancy often find lodgement in places that can be explored only with painstaking effort. It is possible that surviving tortoises may again be found on Duncan, Hood, James and Abingdon islands.

There are a few records respecting the length of time tortoises lived on board the whaleships. An entry in the log of the bark *Equator* of New Bedford, on September 8, 1846, reads: "killed our last Terpen which has lived on air for four months and made a good mess for all hands." This evidently was the last of the one hundred fifty tortoises taken by the *Equator* from Albemarle Island on April 22d of the same year—four and one-half months before.[7]

Morrell says "I have had these animals on board my own vessels from five to six months without their once taking food or water. . . . They have been known to live on board of some of our whaleships for fourteen months." Porter says "No description of stock is so convenient for ships to take to sea as the tortoises of these islands. They require no provisions or water for a year. . . . They have been piled away among the casks in the hold of a ship, where they have been kept eighteen months."

It is known however that tortoises lived indefinitely on board vessels and that whaleships frequently kept one or two throughout the voyage of two years or more, as pets, finally landing them alive at the home port. The following information on this point, was contributed in September, 1924, by Mr. George A. Grant of Nantucket, who spent the greater part of his life as a whaler, and who visited the Galapagos: "Shortly after the ship *Niger* of New Bedford

[7] See extracts from log of *Equator*, Appendix, p 118

left the Galapagos, one tortoise disappeared. Two years later when the ship arrived at New Bedford, the tortoise was found alive among the casks in the lower hold."

Several citizens of New Bedford and Nantucket have spoken recently of tortoises that were brought home years ago by whalers. Mr. Frank Wood, curator of the Whaling Museum at New Bedford, related his experience with two tortoises brought home in the early 'sixties by a whaleship owned by his uncle Mr. Edward W. Howland. who kept them in his garden. Mr. Wood spoke of riding on them, saying that a tortoise had first to be started, after which he got on its back.

According to Mrs. Johnson Whiting of West Tisbury, Massachusetts, Captain James Cleaveland, of the ship *Seaconnet* of New Bedford, brought home two tortoises in 1873. They were kept in his yard where they ate grass and were very contented until cold weather came when for lack of suitable winter quarters they were killed and eaten. In "Four Years Aboard the Whaleships," by William B. Whitecar, Jr., on page 97, the author tells of a Madagascar terrapin that was kept in the hold of a whaler for fifteen months and at the end of that time was "still quite fat and good eating."

The name tortoise was seldom used by the whalers. They knew the animals as terrapin, which they usually spelled "turpin" but there were many variations; captains, mates and occasional seamen keeping private logs, wrote it "turpin," "turpine," "tarpain," "turupin," or "terapen," the spelling depending as Sam Weller says "on the taste of the speller." When at anchor, the shipkeeper sometimes wrote in the log, "the boats ashore turpining" or "all hands a-turpining." In the log of the ship *Loper* only, are they referred to as tortoises.

There is nothing in the logbooks of the whalers respecting the habits of tortoises, but this subject is well presented in an interesting and important article by R. H. Beck, which was published in the "Report" of the New York Zoological Society for the year 1902.

The sizes attained by tortoises of the Galapagos were probably as great as those recorded of tortoises taken from islands of the Indian Ocean, one of which, now in the British Museum, had a weight of eight hundred and seventy pounds. They may have been even greater, but the weights of the monsters described by whalers

in the following pages were estimates only. In the matter of length we are better informed. There are specimens in European museums in which the straight length of carapace exceeds four feet and in American museums, three and a half feet, Porter describes the taking of tortoises on Indefatigable Island in 1812 "of an enormous size, one of which measured five feet and a half long."

The Galapagos tortoise described by Messrs. Daggett and Heller, lived sixteen years in California, having attained a length of forty-one inches and a weight of four hundred and fifty pounds. It was a young tortoise when captured. The weight of Porter's five and a half foot tortoise may have approached those celebrated among the whalers as giants of marvellous size.

While American whaleships, numbering more than seven hundred at one time, did not all go to the Galapagos, or even to the Pacific, those that did so undoubtedly made repeated visits, as the logs at hand indicate. It would be within safe limits to credit American whalers with taking not less than 100,000 tortoises subsequent to 1830. The whaleships of other countries also visited the Galapagos, although not to the same extent.

There are no records available respecting the possible numbers of tortoises removed from the islands by passing merchant vessels during the whaling period and preceding it. This source of destruction continued as long as tortoises were available either by hunting or by purchase from the settlers. No one has attempted to summarize the captures made by the early navigators that have left records, and little is known of what the buccaneers and the sealers that followed them did to the tortoises. A couple of centuries of tortoise hunting prior to the advent of the whalers must have resulted in the taking of great numbers. It doubtless would be possible to recover some of the logbooks of the sealing fleet. The men-of-war also are to be considered, since like the buccaneers, they had larger crews to feed than the whalers. Porter confesses to loading "about fourteen tons" of tortoises from James Island on one of his ships in 1812. He also mentions taking on board "between four and five hundred" at Charles Island.

The greater part of the destruction subsequent to the establishment of the first settlement in 1832, may well be attributed to the hundreds of Ecuadorian inhabitants on Charles, Chatham and Albemarle islands who found in the tortoises not only their main

subsistence for many years but the basis of the oil making industry that, according to Beck, was still in progress in 1906.

Doctor Bauer's supposition that ten millions of tortoises were carried away by ships may be incredible, but there is little doubt that such figures would be required to account for the enormous numbers that have disappeared in various ways since the discovery of the Galapagos.

While the object of the writer in the present paper is to report upon the hitherto overlooked records of the whaling fleet, he can not entirely ignore the problem of the origin of the tortoises for which the Galapagos Islands are chiefly celebrated.

The long-isolated and very peculiar animal and plant life of the islands is remotely of American origin. In attempting to account for its presence some naturalists are disposed to accept a theory which presupposes a former land connection between these volcanic islands and the mainland. This would require as Milton says, "a bridge of wond'rous length." The coast of Ecuador lies five hundred miles from the most easterly of the islands, with ocean depths between as deep as two and a half miles. In the direction of Central America the distance is six hundred miles, with intervening depths exceeding two miles. Participation in the actual work of sounding these depths has naturally served to render their measurements impressive to the writer.

If a former land bridge from the American tropics, with their surpassingly rich fauna and flora, is necessary to account for the very limited number of animal and plant forms inhabiting the Galapagos, it is pertinent to inquire, *why was it so little used?* Mammals are represented only by a few bats, of land birds there are only about sixty species, of reptiles only twenty-six, and of insects and of plants only a few hundreds. The transportation of some of these can be accounted for readily in other ways:

The numerous islands, one of them seventy-two miles long in a north and south direction, extend through one hundred thirty miles of latitude and one hundred forty of longitude. Lying directly across the paths of the prevailing westerly currents and winds the position of the Galapagos Archipelago is such as to favor the accumulation of drifting objects. With such conditions enduring through a long period of time, it is inconceivable that various forms of living flotsam could have failed to arrive there.

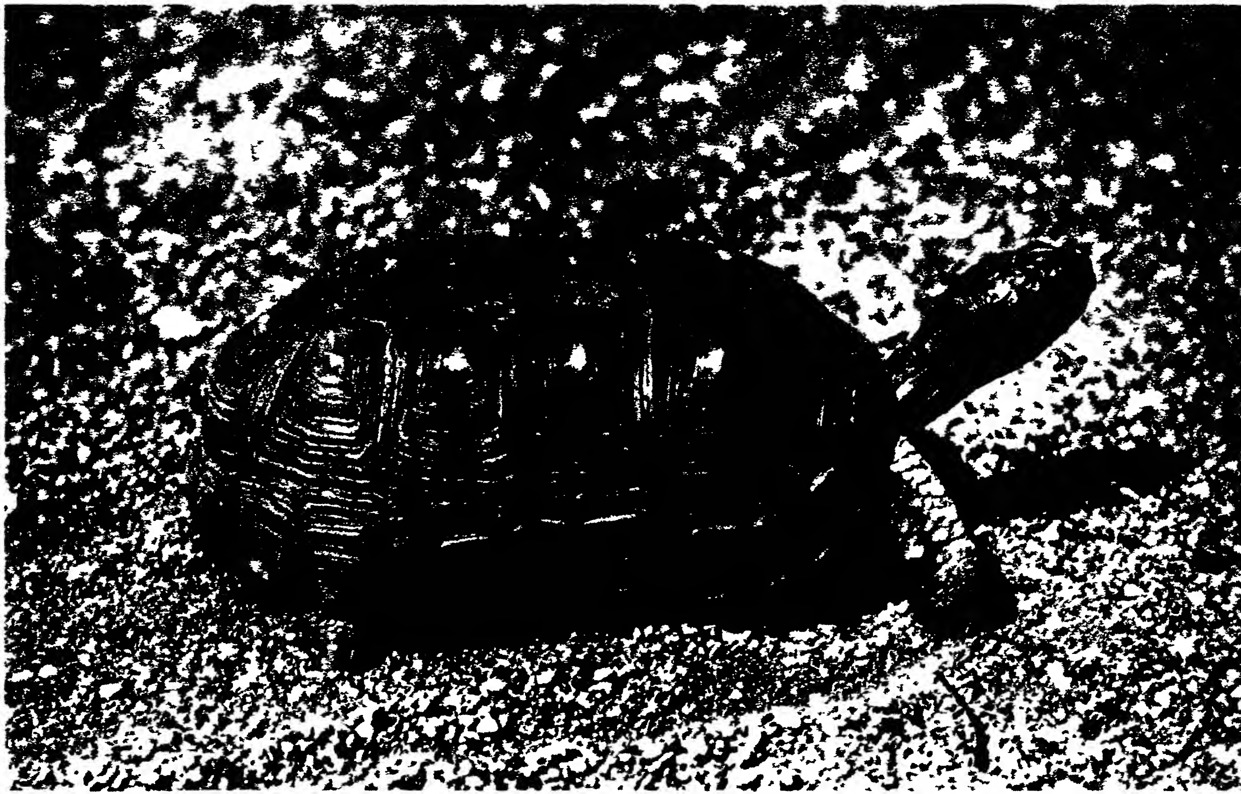


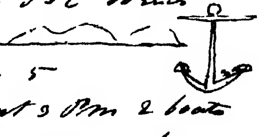
Fig 23 The South American tortoise (*Testudo tabulata*) with which the origin of the Galapagos tortoise is doubtless connected Collected on the Isthmus of Darien in 1924 by Charles M Breder Now in the New York Zoological Park

The hardy tortoise, able to live for months without food or water, and like all four-legged animals, able to float and even swim for a time, would have as good a chance to survive the voyage as the lizards or any of the early involuntary Galapagan immigrants that lacked the power of flight. The ancestry of the island tortoises need not be regarded as mysterious, with so close a relative as *Testudo tabulata* living no farther away than the Isthmus of Panama. Within the past year, our associate, C. M. Breder of the Aquarium staff, has found this large and widely distributed species living in considerable numbers on the Isthmus, where it is a common pet with children of the native villages. He also brought living specimens to the Aquarium. Individuals are recorded of more than two feet in length of shell. What size and coloration it might acquire, if removed from the rainy forests of the Isthmus, where it is subject to human molestation, and placed in the dry volcanic environment of the Galapagos, affords food for thought. The longer we contemplate this Panama tortoise, with characteristics differing but little more from the average Galapagan animal than do the various island forms of the latter from each other, the more are we disposed to agree with Garman that "the origin of the Galapagos tortoises is directly connected with the species *Testudo tabulata* of northern South America."

It is within the range of possibility that the introduction of tortoises was brought about through human agency. While there is no evidence that these islands were known to primitive man, there is also no evidence that he was not there temporarily. With a vast, populated mainland lying a few hundreds of miles to windward and from which currents set continually toward the islands, it is conceivable that canoes or floating trees with castaway tortoises might have drifted there. All explorers of the rivers of tropical America are familiar with the food gathering canoe of the aborigine. Whatever agency was responsible for the tortoises, and that will doubtless remain unknown, they found abundant food and no enemies at the Galapagos. Their amazing development both in size and numbers was a matter of isolation under conditions exceptionally favorable to them.

The only other instance of existing species of tortoises attaining equal development, was under similar conditions on islands in the Indian Ocean.

Remarks on Sunday December 4
This 24 hours begins with brisk trades Steered N E all
sail set at 7 PM Hoods island East Point Bore Northe
distent about 3 Leagues Shortened sail and hauled on a
wind East S E under 3 Top sails jibb & Spanker
at 12 midnight Lay the main Top sail a Back headed
to Eastward at 6 AM saw the land steered in for the
S. harbour of Hoods island at 11 AM Let go the Larboard
Anchor in 17 fathoms of water payed out 65 fathoms
of Chain at noon moderate wind from S S E So ends



Remarks on Monday December 5
This Day begun with brisk Trades at 3 PM 2 boats
went on Shore after Terrapin at 7 PM returned brought
off about 30 at 6 AM 3 Boats went on Shore after Terrapin
Latter part of this 24 hours moderate Trades and Light
Drisk of rain at 9 AM Longitude By Chronometer W 89° 27' 30
Laying in Hoods island harbour So Ends this Day

Remarks on Tuesday December 6
This 24 hours begins with moderate Trades from S E
3 Boats on Shore after Terrapin at 7 PM Boats returned
on Board Brought off about 100 Terrapin Through the
Night moderate Trades Latter part the Same at 6 AM
3 Boats went on Shore after Terrapin Latter part of
this 24 hours pleasant weather So Ends this 24 hours

Remarks on Wednesday December 7 1831
This 24 hours begins with moderate Trades S S E Light squalls
of rain at 6 PM the Boats came on board brought off
about 90 Terrapin Through the night moderate wind..
at 5 AM 3 Boats went on Shore after Terrapin....
at Noon moderate Trades S S E So Ends this day....

Fig. 24. A page from the logbook of the whaleship *Isabella* of New Bedford. At Hood Island, Galapagos in 1831. Between December 4 and 8, this vessel captured 335 tortoises.

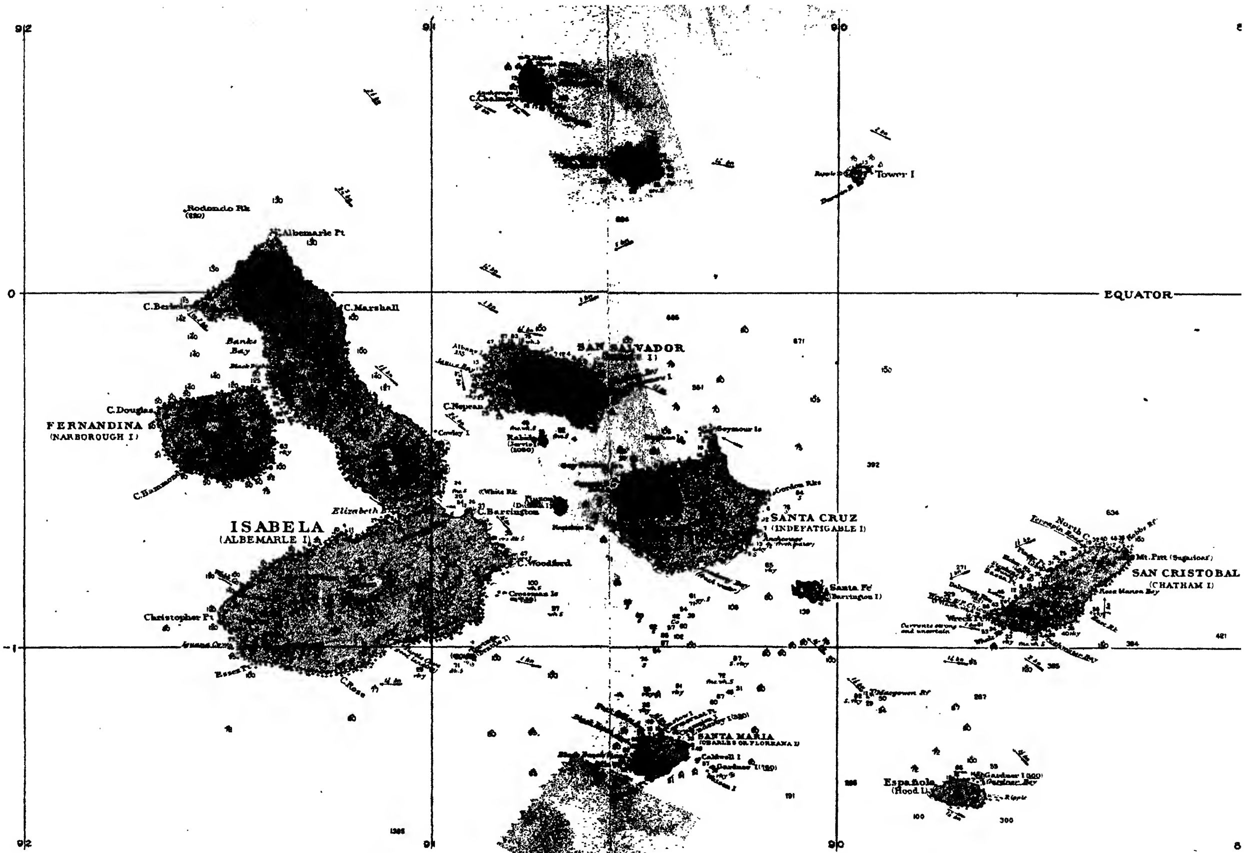


Fig. 25. The Galapagos Islands. The small northern islands of Culpepper and Wenman omitted. From U.S. Navy Chart No. 1798.

In the following list of vessels there is shown a catch of 10,373 tortoises. The number of vessels participating is given as one hundred and fifty-one, but it should be understood that this number means *visits when tortoises were secured;* many vessels having called at the islands two or more times. The ship *George and Susan* obtained tortoises seven times between 1835 and 1856; the ship *Hector* seven times between 1832 and 1843, and the ship *Congaree* eight times between 1847 and 1853. Large catches were often made. Four vessels took over three hundred each, eight other vessels over two hundred each, thirty-three over one hundred each, and twenty-four over fifty each.

The largest recorded catches of tortoises from a single island are 350, 335, 315 and 310:

TORTOISES TAKEN FROM THE GALAPAGOS ISLANDS BY CERTAIN WHALESHIPS FROM 1831 TO 1868[8]

Catch shown by Islands

Year	Vessel	Island	Tortoises
1831	Ship *Isabella*	Hood	335
"	" *Magnolia*	Charles	155
"	" *Hesper*	Hood	250
"	" *Frances*	Charles	179
1832	" *Abigail*	Hood	50
		Abingdon	8
"	" *Hector*	Charles	226 plus
1833	" *Hector*	Albemarle	9
"	" *Pacific*	Indefatigable	44
1834	" *Abigail*	Indefatigable	140
"	" *Bengal*	Charles	100
"	" *Moss*	Chatham	8
		Charles	350
"	" *Loper*	Hood	237
"	" *Hector*	James	23 plus
"	Bark *Benezet*	Charles	120
		Indefatigable	12
1835	Ship *Barclay*[9]	Charles	50
"	" *Hector*	James	124
		Albemarle	2
"	" *George & Susan*	James	68

[8] For extracts from the logbooks of these vessels see appendix, where they are arranged chronologically as in this list

[9] First voyage made in 1795.

1835	Bark *Benezet*	Charles	40
		Abingdon	12
"	Ship *Lima*	James	35 plus
		Albemarle	67
"	*Phoenix*	Abingdon	10
		Hood	65
1836	Bark *Pioneer*	Indefatigable	2 plus many
"	Ship *Eliza Adams*	Albemarle	23
"	Bark *Hesper*	James	13 plus many
"	Ship *Lima*	Chatham	20
		James	118
1837	" *Abigail*	Abingdon	142
"	" *Eliza Adams*	Charles	24
"	" *Lima*	James	224
"	" *Omega*	Chatham	240
1838	" *Corinthian*	Hood	136
"	" *Charles*	Albemarle	8
"	" *George & Susan*	Chatham	67
"	" *Phoenix*	James	12 plus 7 boat loads
1839	" *George & Susan*	Barrington	22
"	" *Charles*	Albemarle	20
"	" *Robert Edwards*	Hood	12
		Albemarle	7
1840	" *Robert Edwards*	Chatham	59
"	" *Rousseau*[10]	Hood	45
"	" *Mariner*	Chatham	115
1841	" *Elizabeth*	Chatham	102
"	" *Chili*	Albemarle (Crossman)	16
		James	93
		Albemarle	10
"	" *Rousseau*	Albemarle	12
"	" *Pocohontas*	Albemarle	47
"	" *Hector*	Albemarle	24
1842	" *James Munroe*	Albemarle	64
"	Ship *Eagle*	Albemarle	36
"	" *Rousseau*	Albemarle	10
"	" *Chili*	Chatham	118
"	" *Lion*	Albemarle	5
"	" *Robert Edwards*	Chatham	107
"	" *Hector*	Hood	173
"	" *Navigator*	Chatham	30
		Hood	5
1843	Bark *Garland*	Hood	100
"	Ship *Robert Edwards*	Chatham	262

[10] The oldest whaler built in 1801 for Stephen Girard of Philadelphia. Broken up at New Bedford in 1893.

1843	" *Hector*	Abingdon	67
1844	" *Callao*	Hood	20
		Albemarle	4 plus
1844	Bark *Equator*	Chatham	24
		Albemarle	9
"	Ship *Levi Starbuck*	Hood	14
		Chatham	130
"	" *Charles*	Chatham	100
1845	Bark *Equator*	Albemarle	69
"	" *Alfred Tyler*	James	20
		Abingdon	7
		Indefatigable	45
1846	" *Equator*	Albemarle	150
		Chatham	14
"	(Name lost)	Chatham	190
"	Ship *Aurora*	Albemarle	2
		Hood	7
"	" *Minerva*	Chatham	120
1847	" *Coral*	Albemarle	1
		Abingdon	1
"	" *Susan*	Albemarle (Crossman)	30
"	Bark *Alfred Tyler*	Abingdon	3
1847	Ship *Charles Frederick*	Hood	67
"	" *Aurora*	Chatham	100
"	" *Congaree*	Chatham	4
"	" *Elizabeth*	Chatham	100
1848	" *Susan*	Albemarle	186
		Abingdon	23
"	" *Corinthian*	Chatham	54
"	" *Roman*	Duncan	50
		Indefatigable	36
"	" *Congaree*	Abingdon	10
		Chatham	70
"	" *Coral*	Chatham	200
1849	" *Susan*	Albemarle	2
"	(Name lost)	Albemarle	63
"	Ship *Congaree*	Chatham	130
"	" *Kingston*	Abingdon	6
"	Brig *Vesta*	Hood	1
		Abingdon	5
1850	Ship *Susan*	Chatham	156
"	" *Peruvian*	Duncan	131
"	" *Martha*	Chatham	110
1851	" *Pocahontas*	Chatham	90
1852	" *Congaree*	Abingdon	5
"	Bark *Eugenia*	Albemarle	2
		Chatham	107

1853	Ship *George & Susan*	Abingdon	3
"	Bark *Henry H. Crapo*	Barrington	1
"	Ship *Congaree*	Chatham	315
		Hood	7
"	Bark *Peru*	Albemarle	150
"	" *Martha*	Chatham	13
1854	Bark *Eugenia*	Abingdon	3
"	" *Superior*	Albemarle	1
"	Ship *Potomac*	Chatham	43
1855	" *George & Susan*	Chatham	152
"	Bark *Cornelia*	Chatham	28
		Albemarle	14
"	Ship *Mary Ann*	Chatham	4
		Duncan	17
"	Bark *Superior*	Albemarle	11
"	" *Benjamin Cummings*	Chatham	310
1857	" *Bevis*	Albemarle	13
1858	" *Morning Star*[11]	Albemarle	24
1859	" *Montgomery*	Chatham	78
		Albemarle	7
"	Ship *Lancer*	Chatham	70
1860	Bark *Ohio*	Albemarle	81
"	" *Ospray*	Albemarle	122
"	" *Atkins Adams*	Albemarle	14
"	Ship *Edward Carey*	Albemarle	56 plus
1861	Bark *Stella*	Albemarle	6
"	" *Ospray*	Albemarle	41
"	" *Morning Star*	Chatham	188
"	Ship *Roscoe*	Chatham	50
"	" *Arnolda*	Chatham	42
"	Bark *Atkins Adams*	Chatham	105
"	" *Ohio*	Chatham	50
1862	" *Stella*	Abingdon	4
"	Ship *Edward Carey*	Albemarle	95
"	" *Roscoe*	Albemarle	63
1863	Ship *Edward Carey*	Chatham	1
		Duncan	208
1867	Bark *Osceola 2nd*	Abingdon	1
1868	Ship *Roscoe*	Albemarle (Cowley Islet)	5

Total visits by above-named 67 vessels—151

Total recorded catch 10,373

[11] Built 1843, last voyage 1914, see frontispiece

Above Catch of Tortoises Arranged by Decades

Showing number of visits by vessels and average taken at each visit

Decade	Tortoises	Visits by Vessels	Average
1831–1839	3809	44	86
1840–1849	3567	61	58
1850–1859	1865	28	67
1860–1868	1132	18	63
Total Tortoises	10,373	Total visits 151	General Aver. 68

Same Catch Arranged by Islands

1.	Chatham	4,326	6.	Duncan	356
2.	Albemarle	1,581	7.	Abingdon	310
3.	Hood	1,524	8.	Indefatigable	279
4.	Charles	1,244	9.	Barrington	23
5.	James	730		Total tortoises	10,373

In the following list of twenty-nine vessels making thirty-eight visits to the islands the numbers of tortoises taken are not recorded. Allowing these vessels the same average catch for each decade, as the sixty-seven vessels making one hundred and fifty-one visits, with definite records, their catch may be estimated conservatively as follows:

Estimated Catch of Tortoises

Based on the Recorded Catch—Arranged by Decades

Decade	Visits by Vessels	Average	Tortoises
1833–1838	12	87	1044
1840–1849	14	58	812
1850–1859	7	67	469
1860–1867	5	63	315
	38		Estimated catch 2640

The recorded catch of 10,373 tortoises by vessels making one hundred and fifty-one visits, and the estimated catch of 2640 by vessels making thirty-eight visits, gives a total of 13,013 tortoises taken during one hundred and eighty-nine visits.

List of Vessels Seeking or Obtaining Tortoises at Various Islands from 1833 to 1867, but Numbers Taken not Recorded

Year	Vessel	Island	Date	Logbook Entries
1833	Ship *Loper*	Abingdon	Aug. 7–8	"At anchor at Abingdon"
1834	" *Bengal*	Albemarle	Apr. 1	"went for terrapin"
"	" *L. C. Richmond*	Charles	July 16	"the boat wint on shore"
"	" *Ohio*	James	Feb. 26– Mar. 1	"employd giting turpin"
1835	Bark *Pioneer*	Charles	May 7–14	"boats returned with turpin"
"	Ship *Lima*	Chatham	June 23–25	"boats returned with turpin"
1836	" *Ohio*	Charles	Apr. 12–15	"boats after turpin"
"	Bark *Pioneer*	Charles	July 16–17	"boats returned with turpin"
1837	Ship *Elizabeth*	Albemarle	May 17–18	"obtained Terapine"
"	" *Eliza Adams*	Indefatigable James	May 7–9	"imployed geting turpin"
1838	" *Omega*	James	June 26– July 2	"stowing Terrapin"
1842	" *Ocean*	Albemarle (Crossman)	Jan. 25–27	"employed turpining"
		Chatham	July 26– Aug. 3	"getting turpin"
"	" *George Washington*	Hood	Nov. 1	"Terrapin very scars"
"	" *James Monroe*	Albemarle	July 2–3	"3 boats loded with turpin"
1843	" *Phebe*	Albemarle	Jan. 12	"got a few Turrapin"
1845	Bark *Alfred Tyler*	Albemarle	Nov. 11–12	"on shore for terphin"
"	(Name lost)	James	Aug. 18–23	"got some turpin"
1846	Ship *Ann Alexander*	Hood	(Records mislaid)	
1847	Bark *Persia*	Hood	Jan. 6–7	"got but few tarapin"
"	" *Alfred Tyler*	Albemarle	Apr. 24–25	"on south head for terphin"
"	Ship *Congaree*	Abingdon	July 10	"one Terrapin"
		Charles	Oct. 26–27	"some Terrapin"
1848	" *Aurora*	Charles	Jan. 12	"got a few Turrapin"
1849	" *Phoenix*	Albemarle	June 25–27	"Several turpin"
1850	Ship *Potomac*	Chatham	Mar. 19–22	"3 boat loads of Terrapin"
		Albemarle	Oct. 18–19	"after terrapin"
1854	" *Montreal*	Albemarle	Jan. 19	"four boats go Turpin"
1856	" *George & Susan*	Albemarle	June 9–10	"after Tarrapin"
1858	Bark *Stella*	Chatham	June 10–12	"few Turpin"
"	Ship *Fabius*	Charles	Mar. 1	"boats ashore after turtle"
1859	Bark *Ospray*	Chatham	July 14–20	"employed Turpining"
1860	Bark *Montgomery*	Chatham	July 8–13	"the crew after Terrapin"
1861	" *Montgomery*	Albemarle	Feb. 9–10	"some Terrapin"
		Chatham	Mar. 15–19	"crew after terepin"

1861	"	*Alto*	Albemarle	Feb. 13	"their boats after terrapin"[12]
1867	"	*Osceola*	Albemarle	Aug. 24–25	"after Turpin"

ESTIMATED CATCH ARRANGED BY ISLANDS. BASED ON RECORDED CATCH

1.	Albemarle	912	5.	Hood	174
2.	Charles	531	6.	Abingdon	145
3.	Chatham	472	7.	Indefatigable	87
4.	James	319			
				Total	2640

The following table of the total catch shows that whaleships obtained a larger number of tortoises during the 'thirties than in any subsequent decade. The catch from 1840 to 1849 was smaller, although more vessels visited the islands. The catch and the number of vessels both decreased during the two succeeding decades:

TOTAL CATCH OF TORTOISES ARRANGED BY DECADES

Decades	Tortoises	Visits by Vessels
1831–39	4853	56
1840-49	4379	75
1850–59	2334	35
1860-68	1447	23
Total tortoises	13,013	Total visits 189
Average per vessel	68	

Arranging the total catch of tortoises by islands, we find Chatham Island, with 4,798, far in the lead in point of numbers taken. Albemarle is next, with 2,493; the position of other islands in respect of catch being in the following order: Charles, Hood, James, Abingdon, Indefatigable, Duncan, Barrington. The yield from the last four is small as compared with the others:

TOTAL CATCH OF TORTOISES ARRANGED BY ISLANDS

Chatham	4798	Abingdon	455
Albemarle	2493	Duncan	356
Charles	1775	Indefatigable	366
Hood	1698	Barrington	23
James	1049		
		Total	13,013

[12] Reported in log of ship *Edward Carey*, February 13, 1861.

Fig. 26. A Galapagos tortoise (*Testudo vicina*) from Albemarle Island, which has lived in the National Zoological Park at Washington for twenty-seven years. Straight length of carapace, two feet. Photograph from the National Zoological Park.

Subsequent to the period under consideration—1831 to 1868, the visits of whaleships had but little effect on the tortoises of the Galapagos Islands. The discovery of petroleum in 1859 affecting the price of whale oil, and the Civil War immediately after, with its heavy losses of vessels, marked the beginning of a decline from which the industry never recovered.

Unpublished Notes on Galapagos Tortoises
Contributed in 1924

Most of the later writers on the tortoises of the Galapagos have quoted extensively from the works of the navigators who saw them in the days of their greatest abundance. We need not here repeat these much-quoted accounts, but there are some works relative to the whaling industry that have not, so far as we know, been quoted in connection with the hunting of tortoises, which contain interesting information on this subject. It is possible to add also some unpublished accounts of tortoise hunting received from veteran whalemen and others while engaged in our search for logbooks of whaling vessels in 1924.

Mrs. Johnson Whiting of West Tisbury, Martha's Vineyard, contributes the following account of tortoise hunting, given her in August, 1924, by her neighbor, Mr. Russell Hancock, a vigorous man of eighty-two: "I went to the Galapagos Islands for terrapin. It was in 1865, on my first voyage to sea on the bark *Samuel and Thomas* of New Bedford, of which my brother-in-law, Captain Wm. Lewis, then of West Tisbury, was master. We landed on Albemarle, uninhabited, of a volcanic mountainous construction, full of crevasses which made it hard and almost dangerous walking. We went ashore at daylight and walked until noon climbing up the mountain and crossing sort of bridges across the crevasses that former parties had made; then we left half our drinking water and went on capturing the terrapin which were feeding on the very sparse tufts of grass. We had hard work finding turtles small enough for two men to carry. When we did we rolled them over on their backs until we had enough, about 50 I think. Many huge turtles had carved on their backs the name of some whaling ship and a date of years before. I have often heard tell that a vessel went over from Panama with two donkeys and procured terrapin so large that two of them weighed 2,200 lbs. We had brought long iron

poles with us and we lashed the terrapins' legs together, slung them on the poles and so carried them back to the ship,—one man on each end of the pole. We valued them very much for fresh meat. I don't think anything ever tasted much better than fried terrapin liver. One thing we used to feed the turtles on board ship was bananas."

Mr. Lafayette Gifford of Westport Point, Massachusetts, makes the statement that his father, who was a whaling captain, "visited the Galapagos in the 'fifties and saw there a renowned tortoise that was supposed to weigh over a thousand pounds. This tortoise had names carved all over its back. A British war ship finally took it away with the aid of tackles and a derrick. It was then but little longer than it was 150 years previously." Perhaps the original dimensions were carved on its back.

Mr. George A. Grant of Nantucket made a visit to the Galapagos in 1881 on the bark *Alaska* of New Bedford. At Perry Isthmus on Albemarle Island he saw a tortoise of extraordinary size that was famous among the whalemen and was known as "Port Royal Tom." There were dates and names carved on his back, the oldest date being 1791. Mr. Grant said that tortoises too heavy to lift were turned on their backs and dragged by means of ropes tied to their legs.

An unpublished note on the Galapagos tortoises, written by Weston Howland, who visited the islands in a whaleship, "probably in 1830," is contribtued by his daughter, Miss Rachel Howland, of Fairhaven, Massachusetts: "We proceeded to James Island, which is about sixty miles in circumference—and there anchored in a safe bay and sent a boat ashore. We found no inhabitants, but a pond of brackish water. Birds were plenty and so tame that a number of them were caught by hand, mostly teal, and the awkward flamingo with its beautiful plumage. In the morning a boat was fitted for an excursion in a bay or cove several miles away, for a load of terrapin. Arriving at the cove, a party consisting of sixteen officers and men, leaving we (two) boys to have a care of the boat, left for a cruise up the sharp volcanic side of the hills, to the feeding grounds of the hard shelled and long necked fellows. The principal food of the Gallipagos terrapin is the cactus tree and grasses which are found on the high lands and which get their moisture from the near neighborhood of the clouds, as it seldom rains on the west

coast of South America so near the equator. The terrapin can and does, live six or more months without water, as he is provided with a vessel or bladder, in which he lays in a stock which he carries with him. This water is at any time as clear as amber and seems entirely pure and clean. The officers and men having returned from their mountain expedition, each with a large terrapin secured on his back, that would weigh seventy-five pounds or more, lunch and a good drink of water was served. They then returned to the feeding ground for another load, which they came back with in time to load the boat and return to the ship before dark, with a supply of delicious food for a month or more."

The catch in this case appears to have been thirty-six tortoises, which, at seventy-five pounds each, weighed 2,700 pounds.

Mr. Paul W. Ryder of New Bedford sends an account of tortoise hunting as related to him in December, 1924, by Captain Samuel Bumpus of Fairhaven, now in his eighty-third year:

Captain Bumpus visited the Galapagos twice in 1860 in the ship *Louisiana* of New Bedford, John Kelly, master. Sixty tortoises were taken at Albemarle Island on the first visit and forty-eight on the second. He saw one tortoise of about 300 pounds lying in a moist spring hole which was too far up the mountain to be carried down. Most of the tortoises were secured about a mile inland. Some of those taken on board weighed as much as 300 pounds, but the average of most of them was from fifty to seventy-five pounds. While on board, the tortoises were fed on potato sprouts and peelings. At that time "turpin" as Captain Bumpus called them, were still plentiful. Fresh water was not found by the crew, which numbered thirty-two men. On the morning of the last day at Albemarle the deck of the *Louisiana* was covered with volcanic ash. Captain Bumpus spoke with enthusiasm of tortoises as food, declaring that the liver was the greatest of delicacies. The meat was usually prepared in the form of a stew called "sea pie." The fat made the finest of shortening.

The following information was given by Captain Gilbert L. Smith of Vineyard Haven, in September 1924:

Captain Smith was the master of the bark *Northern Light* of New Bedford on a voyage that took him to the vicinity of the Galapagos Islands about 1875. He never went ashore at the islands but was near enough to see them. He bought ten or twelve terrapin

Fig 27 A Galapagos tortoise (*Testudo vicina*) drinking From the New York Zoological Park

from a small Ecuadorian vessel that had been sealing at the islands. There were a few vessels from Ecuador that were engaged in sealing and terrapin hunting. The terrapin would be sold for various articles that the whalers might offer in exchange.

Captain Smith said that terrapin were seldom fed anything when kept on board whaleships. Sometimes, however, they were given a few bananas. In his trading with the Ecuadorians, he bought also a barrel of terrapin oil, which he took home and distributed among the housewives that he knew at Vineyard Haven.

Captain Smith said that the terrapin on Charles Island were exterminated very early, and that Albemarle was the island where whalesmen of his day had the best luck. The terrapin were hard to locate, being usually high in the mountains. The smaller ones were carried on a man's back by a strap arrangement, and the larger ones were carried on a pole, borne by two or more men. Captain Smith heard of one terrapin that the finders had to abandon. It was estimated to weigh about a thousand pounds, and the men were unable to get it down to the shore. It was found about four miles inland.

Extracts Relative to Galapagos Tortoises from Works on Whaling

The following passages relative to tortoises are from "A narrative of the Sufferings and Adventures of Capt. Charles H. Barnard, in a Voyage Around the World during the years 1812 to 1816:" published in New York in 1829. The author's first visit to the Galapagos, antedated that of Darwin by nearly twenty years.

Captain Barnard, an American, was on board the British whaler *Eliza* when the latter visited the Galapagos Islands in company with another British whaler. They "came to at Charles's Island," . . . "Boats were dispatched from each ship on the 23d of June (1816) to the shore, to procure terrapin. They were so successful, that at night they returned loaded. . . . After a few days, the *Indefatigable*[13] (a British frigate there at the time) departed for England. The officers and crews of both ships had been actively engaged in procuring a full supply of terrapin." Later, Captain Barnard was on

[13] The vessel for which Indefatigable Island was named

the ship *Millwood* (a merchant vessel) of New York, Captain Bailey, which called at Charles Island to procure tortoises:

"At 4:00 A.M. of the 28th of October, we accompanied Mr. Cole and ten men, in the pinnace, to the black beach, about three miles distant, to procure terrapin: we arrived there at daylight, and proceeded to the spring, about two miles from the landing. We found a great many terrapin there. They were generally too large for a man to carry, and it was only by culling them that one could be obtained to convey down to the shore. While the men were gone to the boat, Mr. Cole and myself searched among the surrounding rocks and brambles for more terrapin, and by selecting the smallest, had procured one for each man on his return from the beach.

"This spring of fresh water, the only one of living water on the island, is resorted to by the terrapin from the most distant parts of it, instinct being their pilot. They remain round the spring several days, occasionally drinking, until they have filled their five internal reservoirs, when having their twelve months' stock on board, they return to their burrows. While we were here, there was a continual stir among them. Those that had obtained their stock were marching off, and others arriving to procure theirs. There was one remarkable for his size, as it was supposed he weighed six hundred pounds. Mr. Cole was desirous to get this mammoth on board, but to carry him to the pinnace was considered almost impracticable. I therefore instructed one of the boys how to manage and drive him, and calculated he would be able to reach the landing place by sunset; but he was one quarter of a mile distant from it, when we came up; for his rogue of a driver, when he thought he was not observed, would get on his back, but the terrapin, not being well broken, would not proceed far without stopping. We turned him over, and lashed him to a tree to prevent his getting away, intending to terminate his land travels in the morning. On getting down to the beach, we found we had thirty-four fine terrapin there. On trial we perceived the boat would not carry them all at once; and accordingly five of them were left, four men remaining at the spring. We started for the ship, but the boat was so deep, and rowed so heavily, that we made slow headway, and it was ten o'clock before we got alongside. . . . On the 29th we got out the long-boat before daylight, and when it was light, Mr. Cole and six men left for the Black Beach, to procure as many terrapin as they could. . . . At 6:00 P.M. the long-boat not

appearing, I went in the pinnace, with a crew, to assist in getting her down, met and took her in tow, and got alongside about eight. Mr. Cole had forty-five terrapin in the boat, including the patriarch. Having now more than seventy on board, Captain Bailey considered that number sufficient."

Extracts from "A Narrative of the Life, Travels and Sufferings of Thomas W. Smith," written by himself, and published in Boston in 1844. The following account concerns a part of his experiences on board a British whaling vessel, the ship *Spring Grove* of London, in the year 1821.

"After this we proceeded to Woods' [Hoods] Island, and came to anchor in a suitable harbor. Here we lay three days, during which time we collected 200 terrapins for the cruise and then proceeded to Charles' Island and from thence to Sea. . . .

"Having watered our ship [coast of Peru] we sailed for the Gallipagos islands to take in a sufficient number of terrapins to last for the ensuing season on the coast. In two days we arrived at Chatham Island, where we took in 300 large terrapins. . . .

"The terrapin resort to the low lands in the rainy season, drinking a sufficient quantity of water, at that time, to serve them during the dry season, which is six months. They then retreat to high ground, in consequence of which the labor of the ship's crew, who go there to collect them, is great; as they have to pass through a thicket of bushes for a mile or two before they can fall in with any of them.

"Individuals have strayed away in these thickets, in search of terrapins, and not being able to find their way out, have perished there for the want of water. My sufferings in this particular, as well as those of some of my ship-mates, were great; and we at times were under the extreme necessity of drinking the blood of the terrapin, and even the water of the animal, with which they like the camel abundantly provide themselves for the season."

The following extracts, relative to tortoise hunting on the Galapagos Islands, are from "The Nimrod of the Sea" by William M. Davis, published in New York in 1874. This work is a composite account of the author's whaling experiences. According to Starbuck's History of the American Whale Fishery, Captain Davis was master of the ship *Chelsea* of New London, on two voyages to the Pacific Ocean—in 1827 and again in 1831. Chapter VIII begins after a landing had been made at Black Beach on Charles Island:

Fig 28 Vegetation near Blackbeach Charles Island Galapagos Photograph by U S S *Albatross* Expedition 1891

"We left two men to prepare camp, while the rest started for the back country to hunt terrapin . . . . . Presently to my surprise, I saw our happy darkey 'Zekiel . . . sitting on the rear of an enormous terrapin about the size of a wheelbarrow, and much the shape of my mother's forty-gallon apple-butter kettle . . . . Here was a 'baste' that would weigh three hundred pounds at least. In the vicinity were numbers of others of more manageable size, and we selected two of perhaps fifty pounds weight. We tied the fore and hind legs of each so as to leave convenient loops through which to slip our arms, intending thus to carry our capture home, knapsack-fashion, on our backs. . . . I have not a certain idea of the weight these creatures attain, but think I am within the mark in placing them at four or five hundred pounds.

"The true way to carry a terrapin is to form a hand-barrow with deal clubs, or for the largest, of the steering oars, such a contrivance, manned by two or ten men, will bring down the capture with comparative ease." Penetrating into higher country the author continues: "Great numbers of terrapin were about, some of them of immense size very much larger than any seen on the shore plains here."

From Chapter IX: "we took the head off the largest terrapin we could find— one great enough to furnish a feast for a hundred men.—We were exceedingly thirsty, moreover, and had tried to satisfy our craving with the warm insipid juice obtained from the trunks of the giant cactuses, but in our capture, in our terrapin, we found the living spring of the wilderness. An ample supply of pure limpid water was discovered in the pearly sack placed at the base of the animals neck. There were some three gallons of water here, and, wonder of wonders, it was cool. The temperature of the animal is but 62°, but that of the country may reach 110° in the sun. . . . With one hundred and fifteen terrapin of all sizes secured, we then returned to the ship whose decks were covered with our sleeping captives and the cook's galley steamed with a new and savory odor."

From Chapter XIX: " A curious feature of the Galapagos is the novel post-office, established there by Commodore Porter, during the last war with England, while the *Essex* harbored in the island which bears the name of her worthy captain. He placed a large terrapin shell on a conspicuous point of Black-lava Rock. As round and white as a huge skull, it is a prominent landmark to vessels

Fig. 29. A Galapagos tortoise (*Testudo abingdonii*) from Abingdon Island. This specimen was among the first of these wonderful tortoises brought to the New York Zoological Park

coasting among the islands. The enormous shell forms the roof of the letter-box, and it is the custom of ships to send a boat ashore and overhaul the mail for any letters that may have been left there for them, and to deposit any letters they may have directed to ships long out which may touch at the islands."

In "Eighty Years Ashore and Afloat," by E. C. Cornell, the following extract concerns an incident in the voyage of the ship *Apollo*. The account is probably true, as there was a ship *Apollo* of Edgartown, which sailed under Captain Daggett on a whaling voyage to the Pacific in 1816. The captain's name, the vessel's name and the year of sailing check with the book's statements:

"After many days reached Charles Island, where we fell in with two Englishman whalers and a Nantucketer. We came to anchor close by them, and everything being secure went on shore after terrapin. Went far into the interior over to Black Beach, so called from its cinderry appearance. Trees called cabbage wood and prickly pears were scattered here and there; only one spring of water was found, and that on the extreme south end. We succeeded in taking a good lot of terrapin, usually selecting those most convenient to carry on our backs, the usual way of transporting them.

"Here we remained about one week, occupying ourselves daily in the same manner. Frequently it required some time to enable us to find the sized ones best suited to our ideas; they were all the way from as large as a silver dollar to the size of a Henry Clay cook stove. Some were so large that they could easily travel with four good-sized men on their backs. Their chief article of diet when on land is the cabbage-tree leaves, which are broken down by the force of the winds; but sometimes when no high winds lay their food on the ground for them, a large number will congregate, and with one accord gnaw into the bark of these trees, till, coming to the pith which is soft and tender, the tree falls before them. The trees grow to the size of half-barrel. I have often taken them from their work and pointed them in another direction, but if allowed they will return to complete their job, never leaving it until it is completed. Though they appear to enjoy eating as well as other animals, yet they will live and thrive on ship-board for months with nothing on which to subsist.

"Three hundred were put on board our ship, stowed between

decks or anywhere out of the way. They were a strange kind of birds; did not seem to care whether they stood on their head or heels. Their meat was most excellent; usually made it into stifles and soups. They were so fat that half a bucket full of grease could be taken from their upper shell when butchered. The fat was sometimes used to shorten those favorite "duffs" previously alluded to.

"The terrapin we had taken were stowed in different parts of the ship, some among the casks between decks, some on deck; it mattered little to us, and apparently less to them, what their accommodations were, so long as they kept out from under foot. With the food they afforded and that of the blackfish constantly on hand, we fared quite sumptously. Our cook used to parboil a sufficient quantity of terrapin over night for next morning's breakfast, when not obliged to be in the boats."

There is a detailed account of tortoise hunting on the Galapagos in Captain Thomas Crapo's "Strange but True" published in New Bedford in 1893, pp. 37–38. Captain Crapo visited Albemarle Island in 1858 in the bark *Greyhound* of Westport, Massachusetts, George G. Cathcart, Master; "On arriving there (Albemarle Island) we dropped anchor. After everything was put in shape, about two-thirds of the crew went ashore, taking with us boat sails to make tents of and water to drink and cook with, as fresh water cannot be found there. After fitting up our temporary camp we started for the mountains after turpin, which are very numerous, and are not found on any other islands.

"Turpin are a species of turtle, the shell being in large checks like an alligators skin, and their flesh is unsurpassed as food for soups and stews: its equal cannot be found. The liver is far superior to any kind of meat I ever ate. It is as large as a beef critter's (from a large one), and is many times superior to it in any way you choose to cook it.

"In order to get them we had to go high up in the mountains, as that seems to be their roaming ground. They are black in color and move very slow. We did not disturb the large ones, as we would have had to kill and cut them up and carry the pieces down on our backs, as many of them will weigh, I should think, nearly half of a ton. So we caught the smaller ones, none weighing over five or six hundred.

"We went hunting them every day for a week, and as they are so

Fig. 30. A Galapagos tortoise (*Testudo vicina*) from Albemarle Island, which has lived twenty years in the New York Zoological Park. Weight when received 140 pounds. Present weight, 305 pounds Photograph from the New York, Zoological Park.

clumsy and move so slow, made it an easy matter to capture them. We built a pen to put them in, and while on shore lived on them mostly, and used hard bread from the ship for soups and stews and other ways: the cook dished it out to us. The small ones we caught we carried down to camp on our shoulders, but we had to drag the larger ones. They are perfectly harmless and never known to bite. We caught about a hundred during the time. At the close of the week we took them aboard. Their weights would range from about five pounds to five hundred and over. We put them on deck and between decks, and let them crawl around as they chose. It was all of six months before they were all gone. I never knew one to eat or drink a drop while they were on board, and yet they looked as fat as a ball of butter when they were killed."

A record of tortoise hunting at the Galapagos from "Whaling," By Charles Boardman Howes, New York, 1924, p. 117, is as follows:

Ship *Sukey* of Nantucket, John Macy, Master, at Charles Island, June 14, 1812: "I leave this port this Day with 250 Turpin."

In "Wanderings and Adventures of Reuben Delano," printed in 1846, the author having sailed on the ship *Stanton* of Fairhaven, in 1824, tells of a terrapin hunt he engaged in on Indefatigable Island, where 300 terrapin were taken.

There is a brief reference to Galapagos tortoises in William Mariner's "Tonga," published in Edinburg in 1827, which appears to have been overlooked by writers on this subject. Mariner accompanied the ship *Port au Prince*, whaler and privateer, on a voyage to the Pacific in 1805. The record is as follows:

"On Wednesday the 16th (October) made Chatham Island, one of the Galapagos. Whilst at this place, some turpin (land-tortoise) was procured from on shore."

There are some references to the tortoises of the Galapagos Islands in the journal of David G. Farragut,[14] a young officer attached to the U.S.S. *Essex* in 1813: "At Charles Island we let some of the men go on shore daily to take a run. They amused themselves by appointing one as a cook while the rest went in search of tortoises and water."

Among the captures made by the *Essex* were the British whale-ships *Atlantic* and *Greenwich:* "From these two vessels we secured water and tortoises euough to supply us for some time. On the

[14] Life of Farragut, by his son Loyall Farragut, New York, 1879.

6th of June we saw a beautiful sight, a volcano in a state of eruption on the Island of Narboro."

Writing of the capture of the British whaleships *Georgiana* and *Policy*, he says (p. 23): "In clearing their decks for action, they had thrown overboard several hundred Galapagos terrapins. The appearance of these turtles in the water was very singular: they floated as light as corks, stretching their long necks as high as possible . . . many were picked up, which afforded us an abundant supply of fresh provisions for officers and crew. The meat, cooked in almost any manner, is delicious."

The Preservation of the Galapagos Tortoises

The Executive Committee of the New York Zoölogical Society has signified its intention to procure if possible living specimens of Galapagos tortoises in the hope of averting the impending extinction of these animals. The edible value of the tortoises is sufficient reason for an attempt to locate a number in some southern locality where suitable climatic and food conditions would favor their increase. Their survival in the Galapagos where natives and wild dogs are equally destructive, seems to be quite hopeless.

The last important collection of Galapagos tortoises was that made in 1905 under the direction of Mr. R. H. Beck for the California Academy of Sciences, when about 250 individuals were secured and preserved as museum specimens. More than one hundred of these were found in the high interior of Albemarle Island, where it is possible that survivors persist. This expedition spent nearly a year at the islands.

The taking of such a number for scientific purposes appears to be justified in view of the heavy slaughter by Ecuadorian oil makers that had long been in progress on Albemarle, and was likely to be continued as long as there were profitable returns.

While Galapagos tortoises have lived for many years in the New York Zoological Park, in the National Zoological Park at Washington, in England and elsewhere, they do not breed in northern climates. A fact to be noted in connection with their failure to reproduce is that the tortoises now living in captivity are nearly all males.

Being hardy animals and easily cared for, a number of them

Fig. 31. A Galapagos tortoise (*Testudo vicina*) in a walking attitude. This animal can easily carry a man weighing at least 150 pounds. It is very gentle and tractable and follows the keepers like any domestic animal. From the New York Zoological Park.

should be transported to a carefully selected breeding base, where their protection would be assured.

The present writer visited the Galapagos Islands in 1888 in the U. S. Fisheries Steamer *Albatross*, when eighteen tortoises were obtained from Duncan and Chatham islands; those from the latter having been taken there from Indefatigable Island. He revisited the Galapagos in the *Albatross* in 1891, when a single tortoise was obtained at Duncan Island, no search for tortoises being made on other islands.

All of these reached Washington alive and in good condition but as a result of improper care did not survive the following winter.

On board the *Albatross* they had the freedom of the deck and fed freely on such fruits and vegetables as were available. It is now known that they grow faster than was formerly supposed. According to Messrs. Daggett and Heller a twenty-nine pound specimen taken to California in 1899 doubled its weight annually and in sixteen years attained a weight of 450 pounds. They are also long lived. There are authentic records of individuals that lived more than a century in captivity. It is known that the females lay numerous eggs.

The species of giant tortoise (*Testudo elephantina*) formerly abundant on Aldabra and other islands in the Indian Ocean, but later brought to the verge of extermination, is now increasing under Government protection. In 1906 Mr. M. J. Nicoll visited the Seychelles[15] in the Indian Ocean, and described the giant tortoises now living there:

"In the grounds of Government House we saw a large number of Aldabra tortoises. Some of them were of large size and a great many were newly hatched. We were informed that they bred freely in confinement and that the young grew very quickly.

These tortoises are used for food by the natives and on visiting the market we saw several tethered by the leg and exposed for sale. On all the islands and inhabited islets of this group, there were tortoise farms. In nearly all these farms the tortoises bear a number which is painted in white on the shell. Many farm-owners keep a record of all their stock, while at Government House a complete register is made with the dates of hatching and so forth. At the latter place we rode upon the largest tortoise.

[15] Three Voyages of a Naturalist Scribners, New York, 1908

Fig 32 A Galapagos tortoise (*Testudo vicina*) in action This is the same specimen as shown on page 97 From the New York Zoological Park

All these tortoises have been imported from Aldabra and there are now probably considerably more individuals on the Seychelles than on the former island."

Aldabra and the Seychelles lie north of Madagascar. There can be no doubt that the giant tortoises of the Galapagos are as well adapted to semi-domestication as the great tortoise of Aldabra. Having developed great size and high edible qualities on desert islands, the Galapagos tortoises might prove of great value among our food resources, especially in arid regions. With a steadily increasing population, the world's food production must soon be increased. Three centuries of navigators feasted abundantly on the tortoises of the Galapagos. No other large land reptile ever figured so importantly in the food supply of mankind. The tortoise islands of the Indian Ocean, also visited by food seeking ships, could not apparently, have borne such numbers as the much larger islands of the Galapagos.

According to the late Doctor Van Denburg[16] who reported upon the numerous tortoises collected for the California Academy of Sciences in 1905–1906, the state of our knowledge respecting the numbers of tortoises remaining on the Galapagos Islands is as follows:

	Island	*Species*	*Status–1906*
1.	Abingdon	*Testudo abingdoni*	Rare
2.	James	" *darwini*	Rare
3.	Jervis	" *wallacei*	Very rare
4.	Duncan	" *ephippium*	Fairly abundant
5.	Indefatigable	" *porteri*	Not rare
6.	Barrington	" ?	Extinct
7.	Chatham	" *chathamensis*	Nearly extinct
8.	Hood	" *hoodensis*	Very rare
9.	Charles	" *elephantopus*	Extinct
10.	Narborough	" *phantastica*	Very rare
11.	Vilamil —Albemarle	" *guntheri*	Abundant
12.	Iguana Cove— "	" *vicina*	Numerous
13.	Tagus Cove— "	" *microphyes*	Fairly numerous
14.	Banks Bay — "	" *becki*	Fairly numerous ..
15.	Cowley Mt.- "	" ?	Rare

It is altogether improbable that the conditions of nearly twenty years ago obtain at the present time. The tortoises of the smaller

[16] The Gigantic Land Tortoises of the Galapagos Archipelago By John Van Denburg, Proc Cal Acad Sci, 1914.

islands have doubtless suffered further depletion in numbers. Survivors if sought for are most likely to be found in the large islands of Albemarle and Indefatigable, the interior regions of which are exceptionally difficult to penetrate.

A remarkable fact in connection with the giant tortoises is their amazing abundance at the time of the discovery of the islands. This continued for more than two centuries or until the first settlement in 1832, despite the inroads made upon them by food-seeking ships. All of the early navigators make mention of their abundance. Dampier who visited the Galapagos in 1684 says "It is incredible to report how numerous they are." What a contribution could be made to the world's food supply if the otherwise unimportant islands where, unknown to primitive man, the tortoises reached such an amazing development, could be cleared of the pests introduced by civilized man and the original conditions restored! This is now unfortunately impossible on the Galapagos. The only remaining hope for the race is the establishment of survivors elsewhere.

APPENDIX

Logbook Records of Tortoises Taken from the Galapagos Islands by Certain Whaleships from 1831 to 1868 [17]

1831. Ship *Isabella* of New Bedford, JOSEPH TABER, JR., *Master*. Hood Island 335 tortoises.

Dec. 4—Harbor of Hood Island, anchored.
Dec. 5—"At 3 P. M. 2 boats went on shore after Terapin at 7 P. M. returned brought of about 30 at 4 A. M. 3 Boats went on Shore after Terapin at 7 P M Boats returned on Board Brought of about 100 Terapin
Dec. 6—at 4 A M 3 Boats went on Shore after Terapin at 5 P M the Boats came on board brought of about 90 Terapin
Dec. 7—At 5 A M 3 Boats went on Shore after Terapin at 4 P M Boats returned on Board Brought on Board 65 Terapin
Dec. 8—at 5 P. M. Boats Came on Board Brought of about 50 Terapin."

1831. Ship *Magnolia* of New Bedford, GEO. B. WORTH, *Master*. Charles Island. 155 tortoises.

Dec. 11—"At 4 P M Came to Anchor at Charles Island. . . . Sent four Boats and Crews after Turpin and took about 110"
Dec. 13—". . . Sent three Boats after turpin and Returned with about 45"

[17] Extracts from the logs are quoted verbatim.

1831. Ship *Hesper* of New Bedford, F. T. BROWN, *Master*. Hoods Island 250 tortoises.

Dec. 19—"came to anchor at Hoods Island sent 2 Boats ashore after turpine"
Dec. 20—"Employed in getting turpine"
Dec. 23-24—"These 2 days employed in getting turpine got about 250 altogether which cost us much trouble."

1831. Ship *Frances* of New Bedford, OBED ALLEY, *Master*. Charles Island 179 tortoises.

Nov. 12—" at dark lay our head yards aback to the Eastward of Charles Isle at daylight kepet off for the harbourd at ½ past 10 or there abouts come too in 7 fathoms of water"
Nov. 13—"two boats went a shore after terpin"
Nov. 14—"at night the boats come on board with 28 turpin"
Nov. 15—"the boats come on board with 44"
Nov. 16 "the boats come on board with 63"
Nov. *17*—"we got 44 more terpin"

1832. SHIP *Abigail* of New Bedford. BENJAMIN CLARK, *Master*. Hood Island 50 tortoises. Abingdon Island 8 tortoises.

April 1—"5 A M Hoods Island distant about 10 miles sent 2 Boats Ashore for to get some Turpin"
April 2—"the Boats got 50 turpin . . . all Hands employed Eating turpin"
At sea. *June 2*—"all Hands employed about trying their strength by lifting an large turpin and looking for what we cant see that is sperm whales"
June 6—"tacking off and on Abington 7 A M Captn Clark and second mate went on shore with two Boats to get some turpin"
June 7—"6 P M Boats came on board with 8 turpin"

1832 33. Ship *Hector* of New Bedford. JOHN O. MORSE, *Master*. Charles Island 226 tortoises.

Dec. 27 "kept her off for Charleses Island . . . at 10 A. M. the starboard boat went on shore"
Dec. 28—"at 5 P. M. the boat came on board brought some turpin"
Dec. 29 "at 11 P. M. came to anchor [Post Office Bay, Charles I.] at 3 A. M. called all hands to go after tarpin . . . the governer came on board"
Dec. 30 "at 7 P M the boats came on board & brought 80 tarpin"
Dec. 31—"the boats went after Tarpin 14 miles from the ship"
Jan. 1—"at 6 P. M. the boats came on board & brought 90 tarpain . . . at 2 A. M. the boats weant after turpin"
Jan. 2—"a sundown down the boats came alongside with 6 turpin Later the waist boat went on shore at the landing for 50 turpin that govner cent down the beech"

1833. Ship *Hector* of New Bedford. JOHN O. MORSE, *Master*. Albemarle Island 9 tortoises.

1833. Ship *Hector* (*cont.*)

March 14—"standing off & onn from Albermar the Larboard & waist boats went on shore after Turpin wee found eight vary large ones"

March 15—"the boats went on shore after turpin could not find but one"

1833. Ship *Pacific* of New Bedford; PAUL CHASE, *Master.* Indefatigable Island 44 tortoises.

Oct. 27—"came to an anchor at Indefatagable Island sent 3 boats 21 men on shore after tirpen at dark retirned on board and never saw one"

Oct. 28—"the boats retirned on board with 8 tirpen . . . at daylight got under way and beet up to the weather harbour"

Oct. 29—"sent 3 boats after tirpin"

Oct. 30—"the boats retirned with 27 tirpin"

Oct. 31—"the boats retirned with 9 tirpin"

1834. Ship *Abigail* of New Bedford. BENJAMIN CLARK, *Master.* Porter's Island 140 tortoises.

May 15—"steering for Porters Island [Indefatigable] 4 P M Came to Anchor in Downes Bay in 7 fathoms"

May 16—"Boats came on Board with 21 large turpin"

May 17—"Boats came on Board with 31 turpin"

May 19—"Boats Came on Board with 40 live turpin"

May 22—"the Boats Returned with 40 live terpin . . . we got here 140 Terepin and 10 Boats Load of wood"

1834. Ship *Bengal* of Salem, RUSSELL, *Master.* Charles Island 100 tortoises.

Mar. 22—[Visited the settlement and] "had through the hospitality of one of the residents a good dinner of terrapin at sunset arrived on board the other boates got 50 terrapin larg an small."

Mar. 24—"at 4 A. M. all the Boates whent a boute 12 miles to Swains landing on the N. W. point of the Island after anchoring the Boates we landed on the rocks and by the help of a rope we succeeded in getting up the precipice we found a plain with some large terrapin on of which & Backet to the Boate." . . . "we got 50 terrapin 5 of the large ones died on the rocks at 8 P. M. on board tired oute"

1834. Ship *Moss* of New Bedford. SHUBAEL CLARK, *Master.* Chatham Island 8 tortoises. Charles Island 350 tortoises.

Feb. 15—"at 9 A. M. came to anchor at Charles's island . . . sent all hands A shore after terrapin"

Feb. 16—"the boats came on board with 8 terrapin"

Feb. 17—"the boats came on board with 6 terrapin . . . took the anchor and stood off and onn sent A boat on shore we found the island to be, chatham island by obs"

Feb. 18—"A boat on shore at sunset the boat came of with 8 terrapin"

Feb. 21—"at 4 P M came to anchor in post-office bay at Charleses island . . . all hands A shore after terrapin"

1834. Ship *Moss* (*cont.*)

Feb. 24—"150 terrapin on board." [All hands getting terrapin from Feb. 21 to March 1]

March 1—"finished giting terrapin—got on board the No of 350" [from Mar. 2 to Mar. 13, the men went wooding]

1834. Ship *Loper* of Nantucket. JOHN COTTON, *Master*. Woods [Hoods] Island 237 tortoises.

Sept. 13—"At 6 P. M. the Boats Returned With But 21 Tortoises."

Sept. 14—"One Boat Came on Board With 60 Tortoises & the other 2 Boats Stoped all Night at Day Light the Boat Went on Shore Again"

Sept. 15—"At 5 P. M. the 3 Boats Came on Board With 30 Tortoises"

Sept. 16—"At 6 P. M. the Boats Came on Board with 50 Tortoises"

Sept. 17—"At 6 P. M. the Boats Returned With 35"

Sept. 18—"At 6 P. M. the Boats Returned for the Last Time With 41 Tortoises"

1834. Ship *Hector* of New Bedford. JOHN O. MORSE, *Master*. James Island 23 + tortoises.

April 12—"standing of & onn from James Isle came to anchor at 8 A. M. two boats went after turpin"

April 13—"the boats came on board turpin was vary scarce we got 3"

April 14—"loard three boats & wint after turpin"

April 15—"the boats came on board caught twenty turpin Latter part the boats went after turpin"

April 16—"the boats came again on board did not do vary well"

1834. Bark *Benezet* of New Bedford. CHAS. PITMAN, JR., *Master*. CHARLES Island 120 tortoises. Indefatigable Island 12 tortoises.

Feb. 26—"concluded to go in at Charles Island . . . at 9 A M came to anchor in 12 fathoms water"

Feb. 27—"one Boat after terpin Capt gone to town"

Feb. 28—"at 8 P M Boats all on board with 50 terpin"

March 1—"at 8 P M Boats abord with 30 tirpin"

March 2—"at 5 P M came aboard with 40 tirpin"

April 13—"at 5 killed some tirpin"

. . .

June 4—"at 2 A M came too Anchor at Portors Isle in 8 fathoms water at daylite 2 Boats went a tirpining at sunrise the 3rd Boat"

June 5—"got 8 tirpen"

June 6—"came aboard with 4 large tirpen"

1835. Ship *Barclay* of New Bedford, HENRY COTTLE, *Master*. CHARLES Island 50 tortoises.

July 14—"anchored Charles Island Harbor"

July 15—"at daylight sent 2 Boats for Turpin"

July 16—"at 6 the Boats returned with 20 Turpin"

1835. Ship *Barclay* (*cont*)

July 17—"2 boats a turpining, one Boat to Town for potatoes three of the men Deserted Caleb Halsted Alfred Overtwin Ronald Blanchard the boat returned without them at 7 oclock the Boats Returned with 30 turpin"

July 18—"employed in Wooding Caught the three runaways put the Ringleader Caleb Halstead In Irons and Kept him Below the Gideon Basto [Barstow] Left and the Ships Washington and Baleaner of New Bedford Arrived"

NOTE.—This vessel made her first voyage in 1795.

1835. Ship *Hector* of New Bedford. THOMAS A. NORTON, *Master*. James Island. 124 tortoises Albermarle Island 2 tortoises.

June 3—"steering in for Breakfast Isle at 2 P M let go the anchor in 18 fathoms of water in Compy with stanton of Fairhaven. . . . At 4 A M lowered 3 Boats and landed at James Isle to procure turrapin"

June 4—"At Breakfast Isle . . . at 6 P M Boats Come off with 34 Turapin . . . at Daylight 3 Boats went on shore for Turapin"

June 5—"at 6 P M Boats came off having procured 26 Turapin"

June 6—"at 6 P M Boat Come off with 40 Turupin"

June 7—"at 6 P M the Boats Come off with 24 Turupin"

Nov. 25—"at Daylight kept off for South head [Albemarle] at 7 A M 2 Boats went on shore for turapin at south head lying off and on"

Nov. 26—"at 2 P M the Boats Came off having procured 2 turapin and some fresh fish"

1835. Ship *George and Susan*. D. E. WIGHT, *Master*. James Island 68 tortoises.

Oct. 24—"at six the boats returned with ten terapen. Could not find them anywhere handy had a long ways to go for to get them but we got 68 all told grate and small"

1835. Bark *Benezet* of New Bedford. CHARLES PITMAN, JR., *Master*. Abingdon Island 12 tortoises.

Jan. 1—"at daylite kept of for Abingtons Island at 7 started 2 Boats for tirpen"

Jan. 2—"at 6 P M all of with 10 live and 2 dead ones"

1835. Bark *Benezet* of New Bedford. CHARLES PITMAN, JR., *Master*. Charles Island 40 + tortoises.

April 13—"at 5 a boat went in for Charles Island for tirpen"

April 15—"at ancher . . . the Boat got 40 tirpen"

April 18—"at 6 P M all abord with a few tirpen"

1835. Ship *Lima* of Nantucket. WILLIAM WYER, *Master*. James Island 35 + tortoises. Albemarle Island 67 tortoises.

June 27—"at noon came to anchor at James Iland in 12 fathoms water"

June 28—"went on shore 2 boats returned at 5 with some terrappin"

1835. Ship *Lima* (*cont.*)

June 29—"returned with some terrappin"
June 30—"returned with 20 terrappin"
July 1—"returned with about 15 Terrappin"

* * * * *

Nov. 21—" at 8 A M two boats wemt on shore at south head" [Albemarle]
Nov. 22—"at 3 P M the boats returned with one dozen good Terrappin"
Nov. 25—"at 6 P M came to anchor In Elizabeths Bay . . . at 9 A M 2 boats went on shore after terrappin but saw none"
Dec. 1—"at 4 A M 2 boats went after terrappin at South head"
Dec. 2—"at 5 P M came of with 25 terrappin"
Dec. 3—"at 4 P M went on shore to be there early in the morning"
Dec. 4—"at 3 P M the boats came off with 30 terrappin"
Dec. 7—"killed a terrappin weighing 250 lbs."

1835. Ship *Phoenix* of Nantucket; Isaac B. Hussey, *Master*. Abingdon 10 tortoises. Hood Island 65 tortoises. James Island 7 boat loads tortoises.

Feb. 6—"Steering for Abingtons Island. . . . Sent 2 boats on Shore and and Cat [caught] Sum turping"
Feb. 7—"Got 10 turping"
July 18—"At 5 Came to Anchor At hoods Island . . Employed in giting of turpin"
July 19—"At 7 P M got to the Ship with 45 turpin"
July 20—"At 6 P M got Along side with 20 turpin it being hard to git them
July 23—"At 8 A. M. Came to Anchor At Jamess Island"
July 25—"Git on board with 2 boatload of turpin"
July 26—"Came on board with 2 boat lode of turpin"
July 28—"Came on board with 3 boat lode of turpin"

1836. Bark *Pioneer* of New Bedford. Reuben Russell, 2nd, *Master*. Porters Island. 2 plus many more tortoises.

July 22 – "at 5 P M came too an anker at porters Island. . . . At 4 A M sent two boats for Terpin"
July 23—"at 4 P M The boats returned with two tirpen"
July 24—"at 6 P M one Boat returned with terpin"
July 25– "at 8 P M wone Boat returned with terpin"
July 26—"at 7 P M wone Boat returned with terpin"
July 27—"at 6 P M the Boats returned with terpin"

Note.—This vessel is celebrated for having made the most profitable of all whaling voyages. In 1856 the value of her cargo was $151,060.

1836. Ship *Eliza Ada*[illegible]f Fairhaven, John O. Morse, *Master*. Albemarle Island 23 tortoises.

Aug. 24—"Off S head . . . at 5 a.m. 3 boats went on shore for terpins"
Aug. 25—"got altogether 23 terpins"

1836. Bark *Hesper* of Fairhaven. OBED FOSDICK, *Master.* James Island 13 plus several boat-loads of tortoises.

Feb. 19—"lying off and on James Island at 8 A M Come to Anchor in 8 fathoms water sent 2 Boats wooding one boat Turrapin"

Feb. 20—"1 Boat Turapining"

Feb. 21—"at 6 P M got off 1 Boat load Turrapin. Last part 2 Boats Turrapining"

Feb. 22—"at 6 P M the Boats returned to the Ship loded with Turrapin Last part 2 Boats Turrapin"

Feb. 23—"at 6 P M the Boats returned to the Ship loaded with Turrapin Last part all hands employed Turrapining"

Feb. 24—"at 6 P M the Boats returned to the Ship loded with Turrpin Last part 2 Boats Turrapining"

Feb. 25—"at 6 P M the Boats returned to the Ship loded with Turrapin Last part 11 men Turrapining"

Feb. 26—"at 4 P M the Boat returned to the Ship with 13 turrapin"

1836. Ship *Lima* of Nantucket; WILLIAM WYER, *Master.* Chatham Island 20 tortoises. James Island 118 tortoises.

July 1—"at 4 P M came to anchor at Stephens Bay in 9 fathoms water, . . . went on shore 2 boats after terrappin"

July 2—"came off with about 20 terrapin"

July 3—"at 8 A M came to Anchor at James Iland and went on shore after terrapin"

July 4—"Come off with about 18 terrapin"

July 5—"employed getting terrappin 30"

July 6—"came on bord with 40"

July 7—"brougt on board about 30"

1837. Ship *Abigail.* WM. RAYNARD, *Master.* Abingdon Island 142 tortoises.

Jan. 21—"Went ashore and got two terpen"

Jan. 25—"All hands employed in making belts to go after terpen at Abington island got ashore one oclock sixteen men got 30 terpen"

NOTE.—Another log of this voyage continues the record as follows:

Jan. 26—"laying off and on 2 Boats on shore after Teripin at 7 P M returned with 53 Turinpin"

Jan. 27—"at 9 P M the Boats returned from the shore with 40 Turpin"

Jan. 28—"the Boats on shore for Turipin at 9 P M they returned with 17 Turpin"

1837. Ship *Eliza Adams* of Fairhaven, JOHN O. MORSE, *Master.* James Island several tortoises. Charles Island 24 tortoises.

Oct. 22—"at 2 came to an anchor under Jamses Island and went on shore for turpin at night came of with a few turpin and wood . . . at noon the Omega anchored here." (See Omega, 1837, Chatham Id.)

Oct. 23—"a turpining and wooding"

1837. Ship *Eliza Adams* (*cont.*)

Oct. 24—"imployed in wooding and backing turpin at night came of with a number of turpin"

Oct. 27—"at 2 A M tuck our anchor for the harbor"

Oct. 28—"two boats on Shore at noon came of with 3 Spanyards and 24 turpin the inhabitants of the Island"

[The "harbor" mentioned is doubtless at Charles Island because of the reference to "inhabitants".]

1837. Ship *Lima* of Nantucket; WILLIAM WYER, *Master*. James Island 224 tortoises.

May 28—"at 6 P M James Iland bore West 20 miles dist. . . . at 11 A M came to anchor in 10 fathoms"

May 29—"Employed getting terrappin got 17"

May 30—"got 26"

May 31—"got 17"

June 1—"got 46"

June 2—"got 53"

June 4—"got 65"

1837. Ship *Omega* of Nantucket; ALBERT C. GARDNER, *Master*. James Island ? tortoises. Chatham Island 240 tortoises.

Oct. 23—"came to Ancor on the N E side of James Island"

Oct. 24—"imploied turpining"

Oct. 25—"tuck the Ancor and but to sea"

Oct. 28—"Came to Ancor in Chatham Island"

Oct. 29—"All hands on shore for turpin."

Nov. 5—"Boats returned from turpin and maid up the number of 240"

1838. Ship *Corinthian* of New Bedford. LEONARD CROWELL, *Master*. Hood Island 136 tortoises.

June 21—"At 7 A M came to Anchor at hood Island in 19½ fathoms. 3 Boats A shoar after Teripen"

June 22—"at 6 P M the Boats came off got 36 Small Teripen"

June 23—"at 7 P M the Boats came off with 22 Teripen"

June 24—"at 7 P M the Boats came off with 33"

June 25—"at 6 P M the Boats came off With 45"

1838. Ship *Charles* of New Bedford. ——— MORSELANDER, *Master*. Albemarle Island 8 tortoises.

May 16—"at 4 A M went in at the South Head of Alber Marl Island with 2 boats after Terapin"

May 17—"at 9 P M Came on board with 8 large Terapin"

1838. Ship *George and Susan* of New Bedford, H. C. CUSHMAN, *Master* Chatham Island 67 tortoises.

1838. Ship *George and Susan* (*cont.*)

Sept. 2—"P. M. boats came on board with 27 larg tarapin"

Sept. 3—"fitting the boats to go after turapin at 3 P M Called all hands at 4 P M lowred 3 boats Capt. Second and 3d Mates went after tarapin"

Sept. 5—"at 8 oclock P M 2 Boats came on board at 10 P M the other arived brought 40 turapin"

1838. Ship *Phoenix* of Nantucket; Isaac B. Hussey, *Master*. James Island 12 tortoises.

May 4—"At 7 A M one Boat went on Shore to James Isle For turpin"

May 5—"At 5 P M the Boat Return with 12 turpin"

Sept. 25—"At 3 P M A Boat went on Shore [at James I.] For turpen and stopt on Shore all night. . . . Sent another Boat on Shore for turpen"

Sept. 26—"At 3 P M the boats Returned with a few Turpen"

1839. Ship *George and Susan* of New Bedford. H. C. Cushman, *Master*. Barrington Island 22 tortoises.

Dec. 21—"3 boats on shore at barington island at 7 P M came on board with 12 turpin"

Dec. 22—"of the E. end of Barington Island . . . . 3 boats on shore at 6 P M came on board with 10 tarpin"

1839. Ship *Charles* of New Bedford. ——— Morselander, *Master*. Albemarle Island 20 tortoises.

Feb. 14—"Steering in for the South Head of Alber Marl at 3 P M went on Shore with one boat at 7 P M the boat came on board with some wood and 2 Terapin"

Feb. 15—"lying of and on at Albermarle at 6 P M the boats Come on board with 18 Terapin"

1839. Ship *Robert Edwards* of New Bedford. ——— Howland, *Master*. Hood Island 10-12 tortoises.

March 24—"at 7 too boats went on shoar for Terrapins on the South side of Hoods Island"

March 25—"at 4 the boats come off found it to ruged to land with safety 4 of us howeve got on shoar and got 10 or 12"

1839. Ship *Robert Edwards* of New Bedford. ——— Howland, *Master*. Albemarle Island 6–7 tortoises.

March 26—"at 7 the cap^{t} went on shoar for Terapin. . . . South head of Albemarl N 12^{m}"

March 27—"one boat on shoar at 4 she come of with 6 or 7 terapin"

1840. Ship *Robert Edwards* of New Bedford. ——— Howland, *Master*. Chatham Island 59 tortoises.

March 31—"sent a boat for terapin at 4 came of with 4 or 5 wee anchored

1840. Ship *Robert Edwards* (*cont.*)

under the W point of Chatham Island in 9 fathoms water . . . two boats on shoar Turpining"

April 1—"the boats came of with 14 Terapin . . . at 4 A M two boats went after Terapin"

April 2—"at 6 one boat came of with 29 terapin lost one boat on the rocks Left 5 men on the shoar and 12 terapin on the bech . . . at 4 A M went on shoar took of the boat and the terapin"

1840. Ship *Rousseau* of New Bedford, LUCE, *Master*. Hoods Island 45 tortoises.

Feb. 2—"saw Hoods Island . . . at 4 o'clock P M came to anchor in 15 fathoms of water"

Feb. 3—"two Boats went after turpin"

Feb. 4—"got 45 turpin"

1840. Ship *Mariner* of Nantucket. GEORGE PALMER, *Master*. Chatham Island 115 + tortoises.

May 18 "at 9 [A. M.] came too [at Chatham I.] with the larboard anchor in 15 fathoms water and sent the boat on shore with 2 gangs for terrapin . . . at night the boats came off without much success"

May 21—"At 5 A M 2 boats went to the east end of the island at 6 P M the came back with 45 terrapin"

May 22—"came back with 30 terrapin"

May 24—"came back with 40 terrapin"

1841. Ship *Elizabeth* of New Bedford, H. F. EASTHAM, *Master*. Chatham Island. 102 tortoises.

July 23—"got 51 Terrapin at night all boats on board"

July 24—"All Boats away, at night returned with 44 Terrapin . . . the Boats went and got 7 Large Terrapin"

1841. Ship *Chili* of New Bedford. D. B. DELANO, *Master*. Crossman Island 16 tortoises. James Island 93 tortoises. Albemarle Island 10 tortoises.

Sept. 19- "laying off and on at Crossmans Isle [Albemarle] 4 P M the boats came off bringing 16 t rrapin"

Sept 20—"heady N W for James Isle 2 P M sent in two boats for terrapin 4 came too in 10 fathoms 8 P M boats came off with two terrapin . . . 2½ A M sent off two boats to Albemarle and one here for terrapin"

Sept. 21—"3 P M boat came off with 7 . . . sent in one boat for terrapin"

Sept. 22—"4 P M boat came off with 8 . . . daylight sent in the boat 11 A M 2 boats came from Albemarle with 10"

Sept. 23—"came off with 8"

Sept. 24—"two boats came off with 26"

Sept. 25—"4 P M boat off with 20 6 P M two boats came with 22 have lost a man . . . daylight sent all hands ashore to look for the lost man"

1841. Ship *Chili (cont.)*

Sept. 27—"could not find him left bread and water and directions in a bottle if any one should ever find him"

1841. Ship *Rousseau* of New Bedford. JOHN E. BRAYTON, *Master*. Albemarle Island 12 tortoises.

Oct. 23—"South head bareing S E 3 Ships in sight at 7 A M the Capt Went on shore with 2 boats to look for Tarrapin"

Oct. 24—"at 9 A M the boats returned with 12 Terrapin"

NOTE.—The oldest whaler. Built 1801 for Stephen Girard of Philadelphia. Broken up at New Bedford 1893.

1841. Ship *Pocahontas* of Holmes' Hole, SMITH, *Master*. Albemarle Island 47 tortoises.

May 14—"saw the island of Albemarl and run for it sent 2 boats on shore for tarpens"

May 15—"the boats came off from shoar with 7 tarpens . . . sent 3 boats on shore for turpens caught a seal"

May 16—"the boats came off with 23 turpens"

May 17—"sent 3 boats on shore to the south of head of albemarl for turpen"

May 18—"the boats on shore for turpen came off and left them on shore with 5 men . . . sent 2 boats on shore for the turpen and men and got them off 17 in number"

1841. Ship *Hector* of New Bedford. JAMES GRAY, *Master*. Albemarle Island 24 tortoises

June 8—off South Head, Cape Christopher, [Albemarle] "At dark the boats returned with some half dozen Terrapins"

Nov. 1—"landed two boats on South Head" [Albemarle] "spoke the Rodman"

Nov. 2—"at 9 P M the boats returned with 10 Terrapin. Rodman about the same. Stood off and on all night: at daylight 7 ships in sight"

1841. Ship *James Munroe* of Fairhaven. BENJAMIN CUSHMAN, *Master*. Albemarle Island 64 + tortoises.

Sept. 15—"Ship laying off and on . . . sent 3 Boats on shore for Turpin South hade [Albemarle] Bairing E N E 10 miles"

Sept. 17—"at 9 P M the Boats came on Board with Turpin"

Sept. 18—"at 9 P M the Boats Came on Board with 9 Turpin"

Sept. 19—"at 6 P M the Boats Came on Board with 8 Turpin"

Sept. 29—"at 7 A M sent 3 Boats on Shore for Turpin at South Hade"

Sept. 30—"at 4 P M the Boats Came on Board with 17 Turpin"

Oct. 1—"at 5 P M the Boat Came on Board with 30 Turpin"

1842. Ship *Eagle* of Fairhaven. SAMUEL PERRY, *Master*. Albemarle Island 36 tortoises.

March 14—"at 3 A M made the Island of Arlbemarl south Head at 9 lowered all the boats and went on shore and at night came on board with 36 Terpine"

1842. Ship *Rousseau* of New Bedford. JOHN E. BRAYTON, *Master*. Albemarle Island. 10 tortoises.

April 12—"at 5 A M went On shore at South head with 2 boats after Terrepin"

April 13—"at 5 P M returned with 10 large Terrapin"

1842. Ship *Chili* of New Bedford. D. B. DELANO, *Master*. Chatham Island 118 tortoises.

Aug. 15—"1 P M spoke Ship Robt Edwards . . . Chathams Isle bearing N. dist 10 leagues . . . latter . . . running for the Anchorage . . . prepared to anchor but seeing a reef ahead on which we had like to run kept off again the R. E. anchored"

Aug. 16—"at 2 P M came too in 17 fathoms found here Ships N Bedford. . . . Aurora. . . . boats terrapining. the ships laying at the lee anchorage sunset the boat came off with three terrapin"

Aug. 17—"sunset came off bringing 9 . . . all hands ashore terrapining brot off 34 + 2 = 36"

Aug. 18—"brot off 35"

Aug. 19—"sunset came off bringing 8 . . . latter came off bringing 27"

1842. Ship *Lion* of Providence, R. I. CHAS. F. HOWLAND, *Master*. Albemarle Island 5 tortoises.

Mar. 19—"Albemarl in sight"

Mar. 21—"the Nantucket and Awashonks in company . . . at 6 went on shore after terapin"

Mar. 22—"in company with Awashonks a teraping. At 6 came off with two and three dead ones"

1842. Ship *Robert Edwards* of New Bedford. ——— BURGESS, *Master*. Chatham Island 107 tortoises.

Aug. 15—"steering in for Chathams Island at Meridian came to anchor ½ mile from the shore in 10 fathoms"

Aug. 16—"the boats went in and got 7 Terapin . . . all hand Terapining"

Aug. 17—"got off 9 Terapin . . . got off 21 Terapin"

Aug. 18—"got off 49 Terapin"

Aug. 19—"took off 21 Terapin"

1842. Ship *Hector* of New Bedford. JAMES GRAY, *Master*. Hoods Island 173 tortoises. Abingdon Island 8 tortoises.

Aug. 25—[Abingdon Island] "at dark the boats returned with some wood and eight Terrapin"

Sept. 24— [Hood Island] "Sent three boats in for Terrapins. They returned at 7 p. m. having taken 25 rather small" (2 lost men)

Sept. 25—"went on shore, found the two lost men and 42 Terrapins"

Sept. 26—"obtained with hard labor 55 terrapins"

Sept. 27—"got 45 terrapins alive and 6 dressed"

1842. Ship *Navigator* of Nantucket; ELIHU FISHER, *Master*. Chatham Island 30 tortoises. Hood Island 5 tortoises.

May 14—"at 2 P M went a shore to Chatham Island the Island barring N N W at 5 come of with 5 tirapen . . . laying of and on"

May 15—"2 boats a tirapining at 5 Com of with 25"

Oct. 20 –"at 10 Saw hoods Island at 11 went on Shore a turipening"

Oct. 21—"come of with 5 turpin"

1843. Bark *Garland* of New Bedford. ALBERT SCRANTON, *Master*. Hood Island 100 + tortoises.

Sept. 30—"At 4 P M Came to Anchor at Hoods Island in 9 fathoms water . . . sent 2 boats to git Tarrapin"

Oct. 1—"the boats Came on Board with a few Tarrapin they were scarce"

Oct. 2—"Sent the Boats to git Tarrapin"

Oct. 3—"the Boats Came on Board with 34 Tarrapin . . . busey gitting Tarrapin"

Oct. 4—"the Boats Came on Board with 26 Tarrapin . . . busey gitting Tarrapin"

Oct. 5—"the Boats Came on Board with 40 Tarrapin"

1843. Ship *Robert Edwards* of New Bedford. ——— BURGESS, *Master*. Chatham Island 262 tortoises

Dec. 19—"At 4 Ship came to anchor in 17 fathoms of watter ¾ of miles from' the shore. Kicker Rock N. W. by N. 2½ Miles Chathams Island"

Dec. 20—"Bought 72 Terapin" ("Terapining" until the 24th)

Dec. 24—"At 9 P. M. Boats all came off and brought the remainder of their Terapin, makeing 190 in all, and 72 that the Capt. Bought"

1843. Ship *Hector* of New Bedford. GEORGE MANTER, *Master*. Abington Island 67 tortoises.

Mar. 1—"10 live terrapins" "some more terrapins—32"

Mar. 2—"obtained about 25 terrapins"

1844. Ship *Callao* of New Bedford. JAMES A. NORTON, *Master*. Hood Island 20 + tortoises. Albemarle Island 4 tortoises. Also "a load" of tortoises.

July 9—"at 4 P M came to anchor in the Roads of Hoods island in 15 fathoms of watt . . . all hands went on shoare in persute of turpin Gut about 20"

NOTE.—During the next four days, all hands went ashore "aturping" each day, but the number of tortoises caught is not recorded.

Nov. 27—"Loard 2 Boats to Goe on shore for Turpin at sonset came of with 4 So ends this day of South Head [Albemarle]"

Nov. 31—"Laying off & on South Head . . . 2 [Dec. 1] boats on shore at 5 P M came off with load" [of terrapin]

1844. Bark *Equator* of New Bedford. THOS. H. MATHEWS, *Master*. Chatham Island 24 tortoises. Albemarle Island 9 tortoises.

1844. Bark *Equator* (*cont*)

April 24—"Came to anchor at Chatham island in 7 fathoms of water Ship frances hear also too boats from each ship went after terpen thear is a Mr gerney lives hear geting out terpen oil his wife & 8 spanyards"

April 25—"at 7 P M the boats retur with 8 terpen to each ship"

April 26—"went again with 8 men & got 8 terpen"

May 14—"cloas in to Charlees islan at 6 P M loard the boats & towed in to 14 fathoms of water one mile N W of black beach"

May 16—"this day we got of 17 barrels of potatoss 30 pumpkins 15 bunches of benaners 50 pound of choacklet paid in trade & som money they com aboard as to a groacery stoar for small stoars at 6 P M got through & set them a shoar"

May 19—"ship being of South head went a shoar with 2 boats fro terpen landed at a crick to weather of goana cove [Iguana Cove, Albemarle] but found no terpen went to leward and landed our boats"

May 21—"got of clear through a verey hevey serf with 7 terpen the ship Daniel webster had two boats ashoar got 2 terpen"

1844. Ship *Levi Starbuck* of Nantucket; JOS. P. NYE, *Master*. Hood Island 14 tortoises. Chatham Island 130 tortoises.

Jan. 31– "at 2 P M we came to anchor in Woods [Hood] Island in 20 fathoms of watter, went on shore to look for tarraping at sun set return to the Ship with one tarraping"

Feb. 1—"the Boats on shore tarraping at night they return to the ship with 13 tarraping"

Feb. 2—"at daylight we got under way from Woods [Hood] Islands and went to Chatham Island, and at sun set we came to anchor in 22 fathoms of watter"

Feb. 10—"at 5 P. M. the bots came for the last time, we have got 130 tarraping large & smal"

1844. Ship *Charles* of New Bedford. — — – GARDNER, *Master*. Chatham Island 100 tortoises.

Feb. 9—"at 4 P M made the Land the East End of Chatham Island bearing W by S Dist 30 miles . . . when within 8 or 10 miles of the Land dispatch'd 2 boats in quest of tarapin"

Feb. 10—"at 7 P M the boats return'd with tarapin"

Feb. 11—"at 5 P M the boats return'd with tarapin"

Feb. 12—"at 5 P M the boat return'd Onboard with Tarapin . . . beat up to the anchorage at daylight anchored in 10 fathoms water"

[On Feb. 13, 14, 15, the men were "employ'd at getting Tarapin"]

Feb. 16—"got under way . . . after Obtaining 100 tarapin"

1845. Bark *Equator* of New Bedford. THOS. H. MATHEWS, *Master*. Albemarle Island 69 tortoises.

May 1—". . . ship heading to the E . . . south head [Albemarle] bearing N W distant 10 milds at 6 P M tacked ship & hauled up the courses"

1845. Bark *Equator* (*cont*)

May 2—"at 8 A M went in with labor & waist boats for terpen & got 11 large ones"

May 3—"went in with two boats to goana cove [Iguana Cove, Albemarle] in company with ship James Allen & got terpen to both ships"

May 17—"at 8 A M being close in to cape Roas [Cape Rose, Albemarle] about 3 miles to the W we went in with two boats for terpen & found nise boat cove & got 27 terpen"

Aug. 20—"sent a boat in for terpen on the third hill from south head [Albemarle] but got non"

Aug. 21—"being up in the head of weather bay sent two boats in for wod at 4 P M got of 8 boat load"

Sept. 17—"at 7 A M went in with two boats fror terpen at Albemar abreast of brattle island at 7 P M got aboard with 23 terpen"

1845. Bark *Alfred Tyler* of Edgartown, LUCE, *Master*. Indefatigable Island 45 tortoises. Abingdon Island 7 tortoises. James Island 20 tortoises.

May 5—"running down for Porters Ileand" [Indefatigable]

May 6—"at 2 P.M. came to under the lee of the Ileand"

May 7—"sent one boats crew after terphin"

May 8—"the boat returned with 12 terphin"

May 9—"the boat returned with 20 terphin"

May 10—"at 7 P. M. the boat returned with 13 terphin"

Sept. 7—"laying of and on at Jameses Ileand at 4 P M the Boat Returned with 8 terphin"

Oct. 2—"run in to Abbington and sent 2 boats for terphin"

Oct. 3—"at 5 P M the boats returned with 7 dead terphin"

Oct. 11—"sent two boats with 13 men to Jameses Ileand for terphin and suckceded in getting 12"

1846. Bark *Equator* of New Bedford. THOS. H. MATHEWS, *Master*. Albemarle Island 150 tortoises. Chatham Island 14 tortoises.

Feb. 4—"at 8 A M went in with two boat & got 12 large terpen goana cove bearing N" [the vessel was "off South head, Albemarle"]

Feb. 5—"captain & went in with two boats & sent off 11 verey large terpen captain & 4 men stayed ashoar goana cove bearing N E"

April 14—"off point Essex" [Albemarle]

April 16—"all this day employed beating up weather bay in company with 3 other sail for terpen"

April 17—"went in & got one live terpen & two dedons" [dead ones]

April 18—"cam to anchor in weather bay tagers cove [Tagus Cove, Albemarle] bearing W N W distant 8 milds in 25 fathoms of water one mild from shoar"

April 20—"got off 14 terpen"

April 21—"got off 80 terpen"

April 22—"took the anchor & towed out in companey with Roussau & Aurora got 26 good terpen"

1846. Bark *Equator* (*cont*)

Oct. 10—"at 7 A M went into fresh water bay]Chatham Island] & got 6 cask of water & 5 terpen"

Nov. 20—"being off freshwater bay took a raft of 9 cask ashoar & filled them & got 9 terpen"

Dec. 7—"being of Essex point [Albemarle] at 11 A. M. went in with two boats for terpen & got 4"

1846. Whaleship—No name found. Chatham Island 190 tortoises.

July 20—"anchored at Chatham Island in 10 fathoms water and all hands after Turpin"

July 27—"went to sea 190 turpin on Board"

1846. Ship *Aurora* of Nantucket; FREDERICK W. COFFIN, *Master*. Albemarle Island (at least 2 tortoises). Hood Island 7 tortoises.

April 16—"standing in to the Bay [Elizabeth Bay, Albemarle] . . . Lat. 00″45 S"

April 17—"trying to get up into the Bay going in pursuit of Turrapin in company with bark's Equator, Franklin & ship Rousseau"

April 19—"came to an anchor in 30 fathoms of water"

April 20—"all hands ashore after Turpin"

April 21—"all hands ashore after Turrapin"

Sept. 1—"off South Head . . . went ashore with one boat & got off the meat of 2 large Turrapin"

Oct. 21—"came to an anchor at Hoods Isld in 12 fathoms of water"

Oct. 22—"One watch ashore got 7 Turrapin"

1846. Ship *Minerva* of New Bedford. J. S. MACOMBER, *Master*. Chatham Island. 120 tortoises.

Nov. 2—"At 10 A M Come to anchor in fifteen fathoms water of Chatham Island"

Nov. 7—"finish Turepning got One hundred and twenty"

1847. Ship *Coral* of New Bedford. HUMPHREY W. SEABURY, *Master*. Albemarle Island 1 tortoise. Abingdon Island 1 tortoise.

May 28—"steering for the S W part of Albamarle at 6 P M Cape Rose bore W by N dist 10 miles . . . Ship off & on"

May 29—"at 10 all on board met with poor success got one Turpin Teripin"

Nov. 24—"At daylight off the S W part of Abington. Went on shore with 2 boats & 20 men for terrapins"

Nov. 25—"At 4 P M boats returned from the shore. Landed at 3 different places on the S side of the island & only found 1 terrapin—By all appearances they had retreated into the mountains as everything appeared to be dried up with the sun. Caught plenty of fish with which the shores abound & killed 1 fur seal"

1847. Ship *Susan* of Nantucket; CHARLES B. RAY, *Master*. Crossman Island 30 tortoises.

June 10—"lying off and on the Island of Abington, boats on shore after terrapin"

June 11—"at 5 P. M. boats came off with terrapin and fish"

June 17—"came to anchor att Portors Island in 7½ fathoms water"

June 18—"Went with 3 boats to Crossmans Island [off Albemarle] after terrapin"

June 19—"At Crossmans Island"

June 20—"Came on board with 30 terrapin . . . took our anchor and run over to James Island and 3 boats went on shore for terrapin"

June 21—"at 4 P. M. came on board with the boats"

1847. Bark *Alfred Tyler* of Edgartown, LUCE, *Master*. Abingdon Island 3 tortoises.

May 24—"Saw Abbington bearing W . . . at 5 A M loured two boats and went on shore for terphin and fish"

May 25—"at 4 P M the boats returned with 3 terphin and plenty of fish"

1847. Ship *Charles Frederick* of New Bedford. H. P. BARNES, *Master*. Hood Island 67 tortoises.

July 30—"came to anchor at hoods island at daylight sent two boats on shore for turpin"

July 31—"at dark the boats came off with 27 turpin at daylight sent on shore again"

Aug. 1 –"at dark the boats came off with 40 turpin"

1847. Ship *Aurora* of Nantucket; FREDERICK W. COFFIN, *Master*. Chatham Island 100 tortoises.

Mar. 27—"came to an anchor at Chatham Isd."

Mar. 28—"a part of the crew ashore after Turrapin got 30"

Mar. 29—"got off 36"

Mar. 31—"got under way & went to sea 100 Turrapin on board"

Oct. 26—"the Capt ashore on Charles Isld got a few Turrapin"

1847. Ship *Congaree* of New Bedford. AARON C. CUSHMAN, *Master*. Chatham Island 4 + tortoises.

July 1—"ship lying off and on at Wreck bay [Chatham] at 2 P M the Capt came off with a few Terapin"

July 6—"at 3 A M hove too off Kickor rock [Chatham] at 8. 3 boats started for Terrapin. Saw 3 ships at anchor at Terrapin Road"

July 7—"at 8 P M the boats came on board with 44 Terrapin"

1847. Ship *Elizabeth* of New Bedford. M. BAKER, *Master*. Chatham Island 100 tortoises.

Aug. 24—[at anchor off Chatham Id.] "3 boats went in a tearpaning"

Aug. 29—[still at Chatham] "took on board 100 Terrapin"

1848. Ship *Susan* of Nantucket; CHARLES B. RAY, *Master.* Abingdon Island 23 tortoises. Albemarle Island 186 tortoises.

June 6—"lying off and on the Island of Abingdon, boats after terrapin"

June 7—"at 4 P. M. boats came on board clean"

June 8—"lying off and on Abingdon at 4 P. M. boats came on board one terrapin"

July 5—"off Abingdon's Island . . . boats shore after terrapin"

July 6—"lying off and on Abingdon at sunset boats came off with 8 large terrapn"

July 9—"boats came off with 14 large terrapin"

Sept. 12—"off south head 2 boats on shore after terrapin at sunset returned with 25"

Sept. 14—"lying off and [on] South head boats on shore at sunset returned with 150 terrapin"

Oct. 19—"Off Albemarle 2 boats on shore after terrapin"

Oct. 20—"came off with 11 terrapin"

1848. Ship *Corinthian* of New Bedford. ——— ARMINGTON, *Master.* Chatham Island 54 tortoises.

June 5—"at 8 A. M. three boats went on shore on the S. E. part of Chatham Island for turapin. . . .

June 6—"at 9 P M the boats returned from the shore with 14 turapen"

Oct. 12—"at 10 A. M. took on board 40 large turapin lying at Anchor at Chatham Island Stephens bay"

1848. Ship *Roman* of New Bedford. SANFORD WILBUR, *Master.* Duncan Island 50 tortoises. Indefatigable Island 36 tortoises.

June 6—"At 7 A M Came to anchor the E side of Albemar i a bay duncans island bearing E by S went off with 6 boats for terpen but found non terpen gon back in the mountain"

June 8—"At 4 A M 3 boat from the Margrate Scot with three of ours went over to duncans island"

June 9—"at 9 P M returned with about 50 terpen"

June 10—"stood across to Porters island [Indefatigable] & came to anchor in conway bay in 7 fathom of water"

June 11—"the captain returned from the setlement reports the potatos full of woms got 30 terpen"

June 15—"At 6 A M got under way & stood down the Jameses island chanel got 36 terpen 14 bunches of benanars"

1848. Ship *Congaree* of New Bedford. AARON C. CUSHMAN, *Master.* Abingdon Island 10 tortoises. Chatham Island 70 tortoises.

July 6—"at 11 A M lowerd 3 boats and went on shore at Abingdon"

July 7—"at 7 P M the boats came off with 7 Terapin 3 live ones and 4 dead ones . . . at 9 A M Went on shore with 3 Boats"

July 8—"at sunset the Boats came off with 3 Terapin one alive"

1848. Ship *Congaree* (*cont.*)

Sept. 24—"at 8 A M went on shore at wreck bay [Chatham] and took off 70 Terapin"

1848. Ship *Coral* of New Bedford. HUMPHREY W. SEABURY, *Master*. Chatham Island 200 tortoises.

Feb. 27—"At 11 came to anchor on the S side of Chatham island at fresh water bay in 28 fathoms water—1/3 mile from the shore. At 12 the Hope came to anchor near by. We have the cascade, a stream of water which can be seen running from the bank at the dist. of 4 miles bearing N. N. E."

[Feb. 28, to March 2 were spent getting terrapin and water]

March 3—"Weighed anchor made sail & steered out to the S in company with the ship Hope. . . . We are 12 miles from our anchorage with 200 terrapin on board most of them large which we obtained very easy as we found them near the shore & but a short dist. from the ship. We also filled up our empty casks with water & could have obtained any amount had we wished. As we found it good watering at the foot of a deep ravine that makes down from the top of the island. A stream running therein which forms a pond back of the beach which is in a fine cave at the foot of the ravine. A ship in my opinion may anchor within 1/4 mile from this place in about 20 fathoms water with perfect safety—from the months of December to April ships in coming to anchor should always keep well to the E. as there is a strong current setting to the W. although we found tides near the shore but the current sets but a very short time to the E."

1849. Ship *Susan* of Nantucket; CHARLES B. RAY, *Master*. Albemarle Island 2 tortoises.

Aug. 15—"off South head . . . sent one boat ashore on south head after a fresh mess of terrapin"

Aug. 16—"bot returned from shore with 2 terrapin"

1849. Whaleship—no name found. Albemarle Island 63 tortoises.

July 17—"went on shore with two boats found a plenty of terepin about two or 2½ miles from the landing. We Succeeded in backing down 8 noble fellows at nine in the evg."

July 18—"Went on shore early in the morn with three boats we made out to back down a bout twenty terepin about 200 cwt (some of them) each, reached the ship about eight in the eve."

July 19—"Started early after terepin to a new place With two boats. Cooper & four others to the old place after two terepin that was left on the road & then made sail for the other place—when we had reached we found that they had all all gone to the mountain & left us to haul the boat up . . . we all returned at dark with a bout twenty terepin"

July 20—"started as usual for the shore at day light & brought down fifteen terepin two that would weigh from 200 to 250 each"

1849. Ship *Congaree* of New Bedford. AARON C. CUSHMAN, *Master.* Chatham Island. 130 tortoises.

July 25—"went into Stephens bay came to an anchor at 6 P M in 17 fathoms of water"

July 26—"took off 98 Terrapin"

July 27—"3 Boats on shore after Terrapin at 4 P M one boat came off with 8 Terrapin"

July 28—"At 10 A M the other boat came off with 7 Terrapin . . . finished getting off 130 Terrapin"

1849. Ship *Kingston* of Fairhaven, LEONARD LUSCOMB, *Master.* Abingdon Island. 6 tortoises.

Nov. 5—"At 7 A M went on Shoare with two boats after Terpin. . . . Laying off and on at Abbington"

Nov. 6—"At 6 P M returned to the Ship with six Terpin"

1849. Brig *Vesta,* OSANDER MAYHEW, *Master,* sailed from Edgartown April 10, 1849 bound to California (not a whaling voyage). Hood Island 1 tortoise. Abingdon Island 5 tortoises.

Oct. 19—"at daylight saw the Island called Hoods Island run down hove to at 10 A M sent 2 boats on shore Looked all day for turpin at night came on board . . . with only one turpin that weighed 41 lbs."

Oct. 21—"at 8 A M lowered two Boats and went on shore at Abingdon Island Cruised all day and took 5 Turpin."

1850. Ship *Susan* of Nantucket; CHARLES B. RAY, *Master.* Chatham Island 156 tortoises.

June 23—"At 4 A M made Chathams Island. . . . 12 M came to an anchor in 19 fathoms water off N. E. point"

June 24—"went on shore with 3 boats at sunset returned with 14 terrapin"

June 30—"at 4 P M boats came off with the last terrapin making all together 156 terrapin"

1850. Ship *Peruvian* of Nantucket; GEORGE B. FOLGER, *Master.* Duncan Island 131 tortoises.

Sept. 17—"at 2 P M ran in and came to an anchor in Grand Harbour Porters Isl in 6 fathoms water . . . at 4 P M 3 boats went across to an island about 10 miles dist [Duncan] for terrapin"

Sept. 19—"at 6 P M the boats returned with 48 terrapin . . . at 4 A M 3 boats started on another cruise across to the island for terrapin"

Sept. 22—"at 3 P M the boats returned from the other island with 83 terrapin"

1850. Ship *Martha* of Fairhaven; ——— SKINNER, *Master.* Chatham Island 110 tortoises

1850. Ship *Martha* (*cont.*)

May 7—"heading in for Chatham Is'd. . . . came to an anchor in 9 fathoms water the Catawba & Empire at anchor Turpapining"

May 16—"got under way . . . with 110 Turpen"

1851. Ship *Pocahontas* of Holmes Hole, J. DIAS, JR., *Master*. Chatham Island 90 tortoises.

Aug. 20—"sent two boats ashore (for terapin) with provisions and water for 3 days"

Aug. 24—"one boat came off to bring a few turpin"

Aug. 25—"at 1 a boat came off with more Turpin—a small sloop from San Francisco after a cargo of Turpin. I should think she would carry as many as 20 good large ones"

Aug. 26 —"one boat came off with a load of Turpin. at 3 the other boats came off in each a load of Turpin making in all about 90 and I think pretty good ones"

1852. Ship *Congaree* of New Bedford. MARTIN MALLOY, *Master*. Abingdon Island 5 tortoises.

Aug. 15—"at 7 A M went on shore at Abington for Terrapin"

Aug. 16—"At 9 P M the boats came on board with 5 Terrapin"

1852. Bark *Eugenia* of New Bedford. WM. WOOD, *Master*. Albemarle Island 2 tortoises. Chatham Island 107 tortoises.

June 2—"at 9 A M went on shore with two Boats at South head [Albemarle] and got two small Terrapin.

* * * * *

Aug. 10—"At 9.30 A M steered for S Bay [Chatham] at noon Came to an Ancor"

Aug. 11—"Took on Board 107 Terrapin"

1853. Ship *George and Susan* of New Bedford, J. S. JENCKES, *Master*. Abingdon Island. 3 tortoises.

Sept. 24—"2 Boats returned from the Shore with the meet of 3 Terrapin and one nice one"

1853. Bark *Henry H. Crapo* of South Dartmouth. SPOONER JENKINS, *Master*. Barrington Island 1 tortoise.

April 12—"Afternoon went on shore to Barington island With one boat for turpin and gut one"

Note.—The log mentions the names of six other whaling vessels in sight of the Henry H. Crapo at that time.

1853. Ship *Congaree* of New Bedford. MARTIN MALLOY, *Master*. Chatham Island 315 tortoises. Hood Island 7 tortoises.

Jan. 3—"run off for the East end of Chatham"

1853. Ship *Congaree* (*cont*)

Jan. 4—"At 4 P M came too an anchor in 12 fathoms in Hobbs Bay . . . the hands after terrapin"

Jan. 5 to Jan. 11—"After terrapin"

Jan. 11—"took off 175 Terrapin"

* * * * *

Sept. 26—"At 3 P M Came to an anchor in Gardners Bay, Hoods Isle"

Note.—The next few days were spent coopering oil and stowing

Oct. 2—"Took on board 7 terrapin"

Dec. 13—"at 8 A M came to an anchor in 14 fathom of water in Hobbs Bay" [Chatham]

Note.—No entry in the log-book between Dec. 13th and 18th

Dec. 18—"finished getting 140 Terrapin"

1853. Bark *Peru* of Nantucket; CHARLES E. STARBUCK, *Master*. Albemarle Island 150 tortoises.

July 8—"boats off after turpin . . . the place where we are is on the east side of Albemarle abrest of Cowleys Island"

[Two other ships in company, the *Sea Queen* and the *Clifford Wayne*.]

July 9—"one off the boats has been onshore abrest of the ship got 5 terapin have not heard from the other boats. they all stop ashore nights Latter part boats returned with 9 terrapin"

July 18—"our terrapin cruise is at an end. we obtained about 150"

1853. Ship *Martha* of Fairhaven. MEADER, *Master*. Chatham Island 13 tortoises.

July 29—"At one oclock P. M. sent two boats on Shore at Chatham island for terpin"

July 30—"at two P M Came On Board with four turpin. . . . Came to an anchor at Chatham Island in fourteen fathoms water and veared out fifty fathoms cable . . . lowered three boats and went on Shore to see if we Could not get Some turpin"

Note.—July 31 to Aug. 2, boats were after tortoises.

Aug. 4.—"the Boats returned with 9 terpin"

1854. Bark *Eugenia* of New Bedford. WILLIAM CATTLE, *Master*. Abingdon Island 3 tortoises.

May 30—"At 3 P M sent Two Boats on shore at Abington Island, Contrary to Orders they remained on Shore all night"

May 31—"At 1 P M one Boat returned with fish, At 10 P M the other one returned with Two Terrapin that they Butchered"

July 4—"At 7.30 A M sent Two Boats on shore at Abington Island, after Terrapin"

July 5—"At 1 P M the Boats returned with one Terrapin"

1854. Bark *Superior* of New Bedford. CHARLES L. NORTON, *Master*. Albemarle Island 1 tortoise.

1854 Bark *Superior* (*cont.*)

Feb. 19—"Steering in for South head [Albemarle] at 1 oc P. M. Scent 2 boats on Shore for turbin got one"

1854. Ship *Potomac* of Nantucket; ENOCH ACKLEY, *Master*. Chatham Island 43 + tortoises.

June 12—"steering N along the E side of Chatam Isl. . . . at daylight steered off N. for the N. E. point of the Isl sent in two boat for turpin"

June 14—"got a few"

Aug. 25—"under the lea of Chatam Isl"

Aug. 26—"At anchor in Terrapin Rroads at 4 P. M. took off 10"

Aug. 27—"took on board 16"

Aug. 28—"got off 9"

Aug. 29—"got on board 8"

1855. Ship *George & Susan* of New Bedford. J. S. JENCKES, *Master*. Chatham Island. 152 tortoises.

June 29—"At 6 P M Boats returned Bring 6 Tarrapine"

June 30—"at 6 P. M. Boats returned Bringing 5 Turrapine"

July 1—"at 7 P M Boats returned Bringing 6 dead ones & 2 live ones"

July 2—"at 10 Boats returned Bringing 19 Tarrapin"

July 4—"At 10 A. M. Boats returned Bring 25 Tarrapine leaving one man behind who got lost one boat in search of the lost man"

July 5—"At 5 P. M. the two Boats returned Bringing 65 Tarrapin and at 7 the other Boat returned Bringing the lost man and one Tarrapin."

July 11—"at 3 Boat went on shore at Stephans Bay. Chatham Island. to finish trading for Terrapin got off 23 more"

Aug. 30—Off Charles Island, "spoke a Brig from the Coast wanted to sell Tarrapin"

1855. Bark *Cornelia* of New Bedford, REUBEN W. CRAPO, *Master*. Chatham Island 28 tortoises. Albemarle Island 14 tortoises.

Oct. 21—"at daylight . . . running in for Chatham Island at 8 A M 2 boats went on Shore for Turpins Ship laying off and on"

Oct. 22—"at Sundown boats Came on board with 18 Turpins and one Turtle"

Oct. 23—"at 5 P M Came to Ancor on the North Side of Chatam Island in 9 Farth of Water . . . got 5 Turpins"

Oct. 24—"at Sundown boats Came on board with 5 Turpins"

Oct. 26—"at 9 A M 2 boats went on Shore at South head [Albemarle] for Turpine Ship laying off and on"

Oct. 27—"at dark boats Came on board with 14 Turpins"

1855. Ship *Mary Ann* of Fairhaven. THOMAS DALLMAN, *Master*. Chatham Island 4 tortoises. Duncan Island 17 tortoises.

Oct. 2—"kept away North for Chatham island at 10 A M the mate & second

1855 Ship *Mary Ann* (*cont.*)

mate went ashore for turpin & stoped untill 8 P M, found seven but did succeed in getting off but four"

Oct. 3—"at 8 A M the first, second & third mates with their boats went ashore & stoped untill 3 P M but could not find any turpin"

Oct. 4—"at noon the first, second & third mates went ashore at Duncan's island & stoped untill 5 P M. they got 17 small terpin"

1855. Bark *Superior* of New Bedford. CHARLES L. NORTON, *Master*. Albemarle Island 11 tortoises.

May 4—"lying of & on South head [Albemarle] to Boats of on shore After turpin At Sunset returned to the ship and Brought 11 turpin"

1856. Bark *Benj. Cummings* of Dartmouth. S. JENKINS, *Master*. Chatham Island. 310 tortoises.

July 22—"Came to anchor at Hobbs Bay Chatham Island for Terrapin 23 men Terapining Got a few"

July 23—"These days Terpining [24 to 31] 150 live Terpin"

Nov. 25·[same voyage]—"Came to Anchor at Chatham Island for Terpin all hands ashore"

Nov. 26 to Dec. 4—"all hands came on board with about 160 Turpin"

1857. Bark *Bevis* of New Bedford. DAVID G. PEIRCE, *Master*. Albemarle Island 13 tortoises.

Feb. 5—"At 7 A. M the Capt. took a boat and pulled in to Iguanno Cove [Albemarle] after terapin"

Feb. 6—"at 4½ P. M. Capt returned with 6 terapin"

March 4—"Off and on at Iguanna Cove. at 7 A. M. sent two boats in after terapin"

March 5—"At 8 P. M. the boats returned with one large and six small terapin"

1858. Bark *Morning Star*. H. D. NORTON, *Master*. Albemarle Island 24 tortoises.

July 27 Elizabeth Bay—"three boates went ashore after Tirpin today found none"

July 28—"Three boates went ashore after tirpin found two or three"

Aug. 5—"at 5 A M all Started up [mountain] again today we got down about 22"

1859. Bark *Montgomery* of New Bedford. R. N. CRAPO, *Master*. Chatham Island 78 tortoises. Albemarle Island 7 tortoises

May 4—"at 9 A M two Boats went in to South head [Albemarle] after Turerpin"

May 5—"at 7 P M the Boats came off with Seven Turerpin"

July 14—"at 3 P M Saw Chatham Ilseland . . . at daylight Steered in for

1859. Bark *Montgomery* (*cont.*)

the Anchorage at 9 A M came to Anchor in twelve fathoms in company with the Ospra three Boats from each bound off after Tererpin"

July 15—"two Boats came down to the Barks with 14 Tererpin"

July 16—"the two Boats went up to the other Boats with Water for the rest and after Tererpin"

July 17 & 18—"after Tererpin"

July 19—"at daylight the Boats started from their landing for the ships with 51 Turerpin"

July 20—"got 13 Turerpin"

1859. Ship *Lancer* of New Bedford. O. FISHER, *Master*. Chatham Island 70 tortoises.

May 24—"Steering S W for Terpin road Chatham Is."

May 25—"all hands on shore for Terpin at 4 P M took twenty on board."

May 26—"at 5 P M returned with 8. this day found the Terpin farther off or about 6 miles from the beach found it very hard to back them"

May 27—"at 4 P M returned with 14"

May 28—"at 5 P M returned with 17 large ones and 3 small ones, makeing in all 65 live ones and 5 that were to large we killed and brought down there meat . . . one man shipped on board he had been there 10 mts all Alone at 7 A M sent A boat for his Clothing"

1860. Bark *Ohio* of New Bedford. DAVID BAKER, *Master*. Albemarle Island 81 tortoises.

July 6—"ankered again at Cowlys Inlet" [Albemarle]

Note.—From July 7 to 9—"all hands on shore geting terpin"

July 10—"All hands employed geting terpin hav got 81 on board"

1860. Bark *Ospray* of New Bedford. J. E. STANTON, *Master*. Albemarle Island 122 tortoises.

July 2—"Bound to Perrys Ismuss [Albemarle] for wood in company with Bark Ohio and Vigilant"

Note.—From the third to the eleventh, the crew was employed getting wood and tortoises.

July 12—"all hands came on Board with 122 Terpin"

1860. Bark *Atkins Adams* of Fairhaven. WILLIAM WILSON, *Master*. Albemarle Island 14 tortoises

Aug. 4—"at 8 P M came to an anchor in weather bay [Albemarle] in 25 fathoms water one eighth of a mile from the shore . . . at 7 A M three boats started in pursuit of Tarrepin"

Aug. 5—"at 7 P M the boats returned without success, found only one Tarrepin in the mountains"

Aug. 7—"at 5 P M Tarrepin cruisers returned with three Tarrepin"

Aug. 8—"at 6 P M Tarrepin cruisers all down from the mountains but four,

1860. Bark *Atkins Adams* (*cont.*)

got ten Tarrepins, found them plenty about fifteen miles from the landing . . . at daylight went ashore and took on board two of the absentees, at 7 A M started in pursuit of Tarrepin at another landing at 10 A M went on shore and took onboard another of the absentees."

1860. Ship *Edward Carey* of Nantucket; FRANCIS M. GARDNER, *Master.* Albemarle Island 56 + tortoises.

Mar. 19—"came to anchor at Albemarle in 18 fathoms of water brattle Iland bearing E by South Sent three boats on shore to look for terrapin"

Mar. 21—"at sunset two boats came off with eleven terrapin the other boat remained waiting for two men which lost their way"

Mar. 22—"at dark the boats came off with a load of wood and twelve terrapin . . . at 3 A. M. got under way and [went] further to the Westward say about five miles. four boats after terrapin at different beaches"

Mar. 23—"at 5 P . M. two boats came off with 26 terrapin & left some penned up on Shore found terrapin quite plentiful the other two boats got 4"

Mar. 24—"boats all on shore all hands seeking terrapin at 8 P. M. boats all got off heavy surff on shore left three terrapin on shore experienced very strong westerly current . . . fresh breeze at daylight sent two boats in after the above said terrapin."

1861. Bark *Stella* of New Bedford. FREDERICK HUSSEY, *Master.* Albemarle Island. 6 tortoises.

June 25—"at 7 A. M. 2 boats went ashore on S. head [Albemarle] & got 2 large Terapin"

Dec 18—"at 9 A. M. two boats went in to the S. head [Albemarle] affter terrapin . . . laying off & on"

Dec. 19—"at 4 P. M. the boats came on board & brought off 4 scutteled Terrapins"

1861. Bark *Ospray* of New Bedford. J. E. STANTON, *Master.* Albemarle Island 41 tortoises.

April 30—"the Bark working up to Elizabeth Bay [Albemarle] at 5 p m came to Anchor Sent a Boat to finde a place to get wood"

May 2—"Latter part Sent 2 Boats in company with 2 from the Levy Starbuck to get Tarapan"

Note.—For the next two days, it is written "much the Same"

May 5—"took the Anchor & ran to the North 12. m. & came to Anchor again all hands after terapin"

"Monday May 6th to Saturday May 11th Employed bringing terapin out of the mountains & geting them on board 41 larg ons"

1861. Bark *Morning Star.* H. D. NORTON, *Master.* Chatham Island 188 tortoises.

Note.—Boats were ashore daily after terrapin from June 27 until July 9.

1861. Bark *Morning Star* (*cont*)

July 10—"all three Boats came on Board each one brought 20 Turpin"

July 11—"Brought the rest of the Turpin which made 188 alltold"

1861. Ship *Roscoe* of New Bedford. G. H. MACOMBER, *Master*. Chatham Island 50 tortoises.

Nov. 30—"At 10 A. M. the boats came on board brought 50 turpin"

Note.—As the boats were ashore daily "after turpin" from Nov. 23 to 30, the above number may or may not have been the total.

1861. Ship *Arnolda* of New Bedford. J. A. CROWELL, *Master*. Chatham Island. 42 tortoises.

June 4—"at 10 A M came to anchor at Chatham Island"

Note.—From June 5 to 10 there were "boats on shore for terapin" daily.

June 11—"at 7 A M took the anchor and went to sea . . . we bring out 42 live terrapins"

1861. Bark *Atkins Adams* of Fairhaven. WILLIAM WILSON, *Master*. Chatham Island 105 tortoises.

July 5—"Employed in geting straps ready to fetch tearpin with"

July 18—"headed in for N E point Hobs Bay Chatham island . . . anchored in 10 fathom of water"

July 19—"Employed in tearpining"

Note.—From July 19 to 31 "all hands Employed in tearpining"

Aug. 1—"all hands Employed in receiveing tearpings on Board. we have on Board 105"

1861. Bark *Ohio* of New Bedford. DAVID BAKER, *Master*. Chatham Island 50 tortoises.

March 10—"at 2 P M ankered at Hobes Bay" [Chatham]

[Another vessel in company]

March 15—"From the last date up to the presant hav been at anker in Hobes Bay hav had three Boats crews on shore geting Terpin hav got fifty on board"

1862. Bark *Stella* of New Bedford. FREDERICK HUSSEY, *Master*. Abingdon Island. 4 tortoises.

June 14—"off & on at Abingdon two boats crews went on shore after Terrapin"

June 15—"at 4 P. M. the boats came on board & brought two live terrapin & two scutled ones"

1862. Ship *Edward Carey* of Nantucket; FRANCIS M. GARDNER, *Master*. Albemarle Island 95 tortoises.

Nov. 10—"Ship heading in for the weather bay [Albemarle] . . . 11 P. M. came to anchor in Thirteen fathoms of water and close to the Clara Bell, Hector and Luisianna"

1862. Ship *Edward Carey* (*cont.*)

[During the next few days the crew was employed cutting wood.]

Nov. 14—"send two boats with seventeen of the hands after terrapin"

Nov. 17—"at 8 P. M. one boat returned with five Terrapin and intirely exhoisted"

Nov. 19—"working up for Iguana Cove where each ship have sent one boat with nine men apeace after terrapin lowered another boat and send up to the place"

Nov. 20—"returned with eleven terrapin and reported seventy more on the beach"

Nov. 21—"at 3 P. M. got all the boats off all hands and about 90 Terrapins in all"

1862. Ship *Roscoe* of New Bedford. G. H. MACOMBER, *Master.* Albemarle Island 63 tortoises.

July 20—Eighteen men on shore after terapin and got eight.

July 22—two boats came on board with terapin.

July 23—the terapin gang came on board at 6 P.M. with fifteen terapin.

July 24—the terapin gang came on board at 6 P.M. with 17 terapin.

July 25—boats came on board at six P. M. with seven terapin.

July 26—boats came on board at 6 P. M. with six terapin.

1863. Ship *Edward Carey* of Nantucket; FRANCIS M. GARDNER, *Master.* Chatham Island 1 tortoise. Duncan Island 208 tortoises.

Dec. 23—"at sunset saw Chatam Island . . . daylight kept away for the Island at 10 A M sent in 2 Boats for Terripen"

Dec. 24—"dropt ancor in 19 faths dist ½ mile from the shore at 11 P M the Boats came off bringing 1 Terripan"

Dec. 26—"stood over to Porters Island at 5 P M dropped ancor in 13 fathoms ½ mile from shore . . . at 4 A M lowered 3 Boats with 21 men & stood over to Duncan Island for Terripan"

Dec. 28—"at 10 A M a small schooner Anchored close to us the Capt went on board bought of them 78 Terripan. . . . Also rec'd a Boat load of Terripan from the Islands"

Dec. 30—"at sunset rec'd the Boats from the Island with a cargo of Terripan"

Dec. 31—"at sunset the [boats] came again with a Cargo"

Jan. 1—"at 4 A M the Boats went back to the Islands at sunset all hands came on board having been gone a week & got 130 Terripan"

1867. Bark *Osceola, 2nd,* of New Bedford, JOHN M. SHAW, *Master.* Abingdon Island. 1 tortoise

June 10—"at 11 A M raised Abingdon steering towards it"

June 11—"went ashore got a mess of fish and one Turpin"

1868. Ship *Roscoe* of New Bedford. GEO. H. MACOMBER, *Master.* Cowley Island [Albemarle] 5 tortoises.

1868. Ship *Roscoe* (*cont.*)
Nov. 20—"at 12 M anchored at Cowleys Islet in 6 fathom W"
Nov. 21—"one boats crew ashore cutting wood"
Nov. 23—"17 men ashore looking for Terrapin at sundown all came off brought 5 small Terrapin . . . employed cuting wood"

Record of Vessels Seeking or Obtaining Tortoises, but Numbers Taken not Recorded

1833. Ship *Loper* of Nantucket, JOHN COTTON, *Master*. Abingdon Aug. 7–8 At anchor at Abington

1834. Ship, *Bengal* of Salem. RUSSELL, *Master*.
Albemarle Island. Tues. Aprill 1 "went for terrapin to the south head"
April 3 "not a drop of water where we shall go next or what we shall do is known to god only."

1834. Ship, *L. C. Richmond* of New Bedford, JOHN TUCKER, *Master*. (Stone Fleet—see ship Potomac p. 134)
Charles Island. *July 16*—"the boat wint On Shore at the Island"

1834. Ship *Ohio* of Nantucket, CHARLES W. COFFIN, *Master*.
Feb. 25—"at 9 A.M. anchored in Jameses island harbour in 16 fathoms water three boats went after turpin"
Feb. 26 to *Mar. 1*—"employd giting of turpin"

1835. Bark *Pioneer* of New Bedford. REUBEN RUSSELL, 2ND, *Master*.
May 7—"At 10 P.M. came too an anker at Charles Island"
May 8—"At 4 A.M. two boats went after terpin"
May 9 to *May 14*—"the boats returned with terpin" every day.

1835. Ship *Lima* of Nantucket; WILLIAM WYER, *Master*.
June 23—"at 3 P M came to anchor at Chatham Iland in 8 fathoms water went on shore two boats returned at 7 a few small terrappin"
June 24—"at 5 P M the boats returned with some terrappin"
June 25—"at 4 P M the boats returned with a few terrapin"

1836. Ship *Ohio* of Nantucket, CHARLES W. COFFIN, *Master*.
April 12—"At 5 P.M. anchored in blackbeach bay [Charles I] in 13 fathoms of water . . . two boats after turpin"
April 13—"two boats after turpin"
April 14—"two boats after turpin & giting of potatoes"
April 15—"three boats after turpin"

1836. Bark *Pioneer* of New Bedford, REUBEN RUSSELL, 2ND, *Master*.
July 16—"At 9 A.M. came too an anker at Charles Island. At 10 A.M. sent one boat for terpin and two boats for wood"

1836. Bark *Pioneer* (*cont.*)
July 17—"At 2 P.M. the boats came off with wood. At 6 P.M. the boat returned with Turpin"

1837. Ship *Elizabeth* of Salem, ISAAC G. HEDGE, *Master.*
May 17—"A.M. Stood in toward Albemarle & boats over for fish & Terapin"

1837. Ship *Eliza Adams* of Fairhaven, JOHN O. MORSE, *Master.*
May 7—"at 3 P M came to an anchor at Porters island" [Indefatigable]
May 8—"imployed in geting turpin"
May 9—"imployed in geting turpin . . . went over to James island for turpin"

1838. Ship *Omega* of Nantucket; ALBERT C. GARDNER, *Master.*
June 26—"standing in for James's Island at 3 P.M. came to anchor in 12 fathoms . . . sent 3 boats in after Terrapin"
[To July 1 the crew was busy hunting for terrapin, but the numbers found are not recorded.]
July 2—"at 10 A. M. Took the Anchor and steered W. N. W. Empd. stowing the Anchors & Terrapin"

1842. Ship *Ocean* of Nantucket; ELIJAH PARKER, *Master.*
Jan. 25—"came to anchor to Poters island in 7 fathoms of water . . . three boats went on Crosmans isl for turpin"
Jan. 26—"employed turpining"
Jan. 27—"employed turpining . . . took the anchor and stood to sea"
July 26—"Came to anchor to chatham island in 13 fathoms of water the Henry of Nantucket lying there"
[From July 27 to August 3, the crew was employed "getting turpin," but the results are not recorded.]

1842. Ship *George Washington* of New Bedford. TAYLOR, *Master.*
Nov. 1—Hoods Il. "At 5 P.M. the boats returned found Terrapin very scars"

1842. Ship *James Munroe* of Fairhaven, BENJAMIN CUSHMAN, *Master.*
July 2—"At 6 A.M. 3 boats went on shore for Turpin at noon, Albamaral S Bore E By S dis 5 miles"
July 3—"At 4 P.M. the Boats came on board Loaded with Turpin"

1843. Ship *Phebe* of Nantucket. SAMUEL W. HARRIS, *Master.* Albemarle Island.
Jan. 12—"got a few Turrapin"

1845. Bark *Alfred Tyler* of Edgartown, LUCE, *Master.* Albemarle — ?
Nov. 11—"at 7 A M spoke the President run in to South Head" [Albemarle] "together and the two Captains went on shore for terphin"

1845. Whaleship—(No name found).
Aug. 18—"came to anchor at James Island after turpin and wood"
Aug. 19—"got some turpin"
Aug. 20—"got some turpin"
Aug. 21—"turpining"
Aug. 22—"turpining and wooding"
Aug. 23—"turpining and wooding"

1847. Bark *Persia* of New Bedford, RICHMOND MANCHESTER, *Master*.
Jan. 6—"the first of this day Ship heading in to hoods island harbour at 2.30 P.M. came to anchor in 8½ fathoms water coral bottom at 5 A.M. went on shoar for tarapin found but verry few"
Jan. 7—"all hands imployed after tarapin . . . got but few tarapin"

1847. Bark *Alfred Tyler* of Edgartown, LUCE, *Master*. Albemarle
Apr. 24—"sent two boats ashore on south head for terphin" [Albemarle].
Apr. 25—"at 5 P M the boats returned with small luck"

1847. Ship *Congaree* of New Bedford, AARON C. CUSHMAN, *Master*.
July 10—"at 2 P.M. lowered 2 Boats and went on shore at Abington 6 miles off, at 9 P.M. got back with part of a Terrapin and some Earth to cure the scurvy"
Oct. 26—"At 7 A.M. went on shore with one boat at Black Beach" [Charles I]
Oct. 27—"At 5 P.M. boat came off with some hogs Terapin and fowls"

1848. Ship *Aurora* of Nantucket; FREDERICK W. COFFIN, *Master*.
Jan. 12—"off and on at Charles Island got a few Turrapin"

1849. Ship *Phoenix* of Nantucket; PERRY WINSLOW, *Master*.
June 25—"Steering for South Head"
June 26—"Steering for the land At 2 P M went on shore At dark came on board with several terepin. . . . At daylight went on Shore with 3 Boats after turpin"
June 27—"At Sunset the Boats came of to the Ship with Several turpin"

1850. Ship *Potomac* of Nantucket; CHARLES GRANT, *Master*.
Mar. 19—"at 2 P M Anchored off Wreck Bay. Chatham. . . . 3 Boats went around on the weather side after Terrapin"
Mar. 20—"1 Boat returned with Terrapin"
Mar. 22—"at 6 A M [boats] started for Stephens Bay at 11 returned with 3 Boat Loads of Terrapin"
Oct. 18—"at 10 A M 2 Boats on Shore after Terrapin . . . Off S. Head" [Albemarle]
Oct. 19—"at 6 Boats came off"

Note.—This vessel was one of the "Stone Fleet" of 40 whaleships loaded with stone and sunk in southern harbors during the Civil War to prevent blockade running.

1854. Ship *Montreal* of New Bedford, S. L. GRAY, *Master.*
Jan. 19—"ship standing in for south head at 7 A .M. lourd four Boats to go shore Turpin. . . . Latter part . . . at 11 A.M. boats com on"

1856. Ship *George & Susan* of New Bedford, J. S. JENCKES, *Master.*
June 9—"off south Head of Albemarle Isl. at 5 P.M. lowered down two Boats went in shore after Tarrapin" .
June 10—"At 4 P.M. Boats returned to the ship"

1858. Bark *Stella* of New Bedford, R. W. HATHAWAY, *Master.*
June 10—"Send in two boats for Turpin and so ended off & on Chatham Island"
June 11—"two Boats shore on Chatham Island looking for Turpin at 5 P.M. returned to the Ship with none"
June 12—"2 boats shore for Turpin at 8 P.M. returned with few"

1858. Ship *Fabius* of New Bedford, GEO. A. SMITH, *Master.*
March 1—Off Charles Island "the boats a shore after turtle"

1859. Bark *Ospray* of New Bedford, J. E. STANTON, *Master.*
July 14—"At 9 A.M. Anchored in Hobbs Bay [Chatham I.] 8 fathoms watter 45 chain"
From the 15th through the 20th "employed Turpining" every day. The number caught is not given.

1860. Bark *Montgomery* of New Bedford, R. N. CRAPO, *Master.*
July 8—"came to an Anchor in Hobses Bay [Chatham I.] at 11 o'clock"
July 9—"one Boats crew a fishin the rest of the Ships Company a terupaning"
July 10, 11, 12 & 13, the crew went after terrapin but no numbers are given.

1861. Bark *Montgomery* of New Bedford, R. N. CRAPO, *Master.*
Feb. 9—"sent in two boats in to Guano Cove after Terapin"
Feb. 10—"the Boats returned to the ship with some Terapin"
March 15—"Latter at 9 o'clock came to an Anchor in Hobses Bay [Chatham I.] "seven fathoms watter in company with the Bark Columbas"
March 16—"sent three Boats from each ship around on the East side of the Island after Terapin about 4 O'clock the boats landed and halled up for the night Latter sent the crews after terepin found a few they ware very scarse"
March 17—"the men returned to the Boats had seen few Terapin latter returned to the Ship"
March 18—"Latter all but 4 men went on shore to look for Terapin"
March 19—"At Sundown returned to the ship"

1867. Bark *Osceola, 2nd,* of New Bedford, JOHN M. SHAW, *Master.* Albemarle
Aug. 24—[anchored at Albemarle, the crew wooding] The Cap gone after Turpin got back at 11 P M"
Aug. 25—"nearly all hands ashore fishing catching turtle pipies and guanoes"

NOTES ON FISHES FROM THREE PANAMA LOCALITIES:

GATUN SPILLWAY, RIO TAPIA AND CALEDONIA BAY.

BY C. M. BREDER, JR.[1]
New York Aquarium

(Figs. 33–38 incl.)

INTRODUCTION

The notes comprising this paper are based on three small collections of fishes which were made while attached to the Marsh-Darien Expedition in 1924 as the representative of the American Museum of Natural History. They were acquired quite incidentally to the main ichthyological work of the trip which was the surveying of the fish fauna of the Rio Chucunaque drainage and is to be reported elsewhere. As these collections have no especial bearing on that work, they are recorded here separately and with it complete the list of fishes taken on the trip, excepting those purchased in the markets simply as museum specimens. Each collection is treated as a unit, since they have no particular connection with each other, and should be considered as independent, being issued together for purposes of convenience.

As with all other papers based on this expedition I am of course primarily indebted to Mr. R. O. Marsh whose financial and other aid made the work possible. Regarding the section on the fishes of Caledonia Bay I am indebted to Mr. J. T. Nichols of the American Museum and to Mr. L. L. Mowbray of the New York Aquarium for assistance in diagnosing some of the smaller examples of the more difficult species. All measurements refer to the standard lengths of the specimens, without caudal. The material is deposited in the American Museum.

FISHES FROM GATUN SPILLWAY, CANAL ZONE

While equipping at Colon preparatory to our plunge into the jungles of Darien the opportunity was taken to make a collection at Gatun Spillway (Fig. 33.). The kindness and aid of Mr.

[1] Illustrations from drawings and photographs by the author.

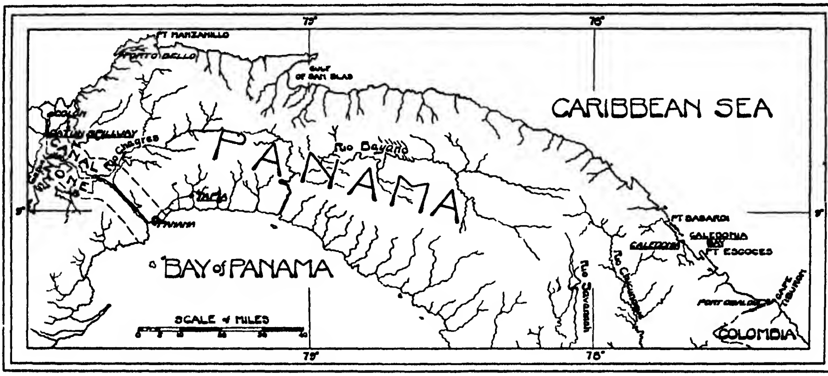


Fig. 33. Sketch map showing the location of the collecting sites at Gatun Spillway, Tapia, on the Rio Tapia, and Caledonia on Caledonia Bay.

William Markham, founder of the Panama Canal Tarpon Club, greatly facilitated the gathering of numerous small fishes at the foot of the spillway and the obtaining of information concerning many of the fishes that reach here only at a large size and of ones not collected during my short stay at the well appointed club house. Mr. Markham remarked, nevertheless, that the present collection was unusually varied and he is in a position to know as he habitually takes his bait fishes at this point. The collection was made on January 26 and 27. Most of the small fishes were taken in a small minnow seine although a dip net was also used. A few gobies were taken in the confluents of the lower Rio Chagres about two miles below the dam and in an overflow from the bait tanks located under the club house. Otherwise all others were taken at the foot of the spillway unless special mention is made to the contrary under the specific headings.

At this point there is a most interesting mixture of the fresh and salt water faunas. The sea fishes working up the stream are of course stopped here where they seem to stay in considerable numbers making the place one of particular favor with both local and visiting anglers. Apparently these marine fishes subsist largely on the many smaller fresh water fishes rushed over the spillway. Numerous larger ones come over also and it is odd that so many survive the swift and turbulent torrent presumably uninjured, but that they do, in part at least, is evidenced by the large number of strictly fresh water forms taken on the hook here. The Rio Chagres

below the spillway is practically at sea level and the slight Atlantic tide can be detected to the very foot of it. This is most prominent when all gates are closed and water is discharging only through the huge hydro-electric plant which operates at all times. The water is fresh, except for the minute and practically negligible amount of salt water that climbs through the locks and comes over by way of the dam, for the sea merely pushes back the river flow during tidal periods.

Usually one or two gates, at least, in the great Gatun dam are left open, supplying water to the lower Rio Chagres, in order to prevent Gatun Lake from rising too high. However, during the dry season these are sometimes left closed for during this period efforts are directed to maintain the necessary depth. Such action causes a rapid lowering of the stream below and leaves many small pools in pockets and depressions on either bank. Formerly these were always found to contain great numbers of small fishes. Sometimes even fishes of a larger size were so ensnared, it not being uncommon to find some running up to ten or fifteen pounds in weight. These were usually snook or jack. For some unknown reason, for the last eight years, according to Mr. Markham, who has carefully studied the fishes of this region from the anglers' point of view, no fishes have been so entrapped by the receding waters, although there has been no marked decrease in River's fauna. Mr. Markham further stated that at no time in his experience has a tarpon been so cut off from the stream. He explains it on the basis that, according to his observations, on the slightest slackening of flow all the tarpon at once rush into mid-stream, the point of maximum speed of current, for at least the tarpon observable from the apron of the spillway react in this manner to the slightest tampering with one of the gates. It would further seem probable that if one were at least partially entrapped it would leap as a reaction to the constraining influence of a small body of water and would soon find its way back to the main stream.

Even this short list of the more prominent species existing at the Gatun Spillway seems especially appropriate at this time for in less than a year after the collection was made the United States Bureau of Fisheries released a number of North American species in Gatun Lake and its confluents. That is, on December 3, 1924, the following species were released (Fisheries Service Bulletin No. 116).

Micropterus salmoides (Lacépède)	4 inch fish	2,250
Pomoxis annularis Rafinesque	2 inch fish	500
Lepomis pallidus (Mitchill)	Fingerlings	500

It will be exceedingly interesting to watch the progress of these fishes, if any, accustomed to a comparatively large seasonal fluctuation of temperature, under tropical conditions, especially as there already exist in the lake various cichlids which appear superficially, at least, to occupy rather similar ecological niches. However, Gatun Lake covers much territory and shows numerous different types of habitat.

At the foot of the dam one of the most striking absences was the complete lack of the smaller characins, for example, such as *Astyanax* which was found to swarm in practically all other places.

The common names given in the list which follows are those used by the local English speaking anglers.

ANNOTATED LIST OF SPECIES

Family I. SILURIDAE

1—*Rhamdia wagneri* (Günther). Catfish.

Fairly common. One example of 179 mm.

Family II. CHARACIDAE

2—*Brycon chagrensis* (Kner). Salmon.

Said to be common by the local anglers. Regarded as a fair game fish and sometimes eaten, but highly relished only by the natives. One example, a green male of 325 mm., stomach empty.

Family III. ANGUILLIDAE

3—*Anguilla rostrata* (Le Sueur). Eel.

Young ones from 54 to 68 mm. common in small pools under flat stones at the foot of the spillway where their further ascent, is prevented.

Family IV. ELOPIDAE

4—*Tarpon atlanticus* (Cuvier and Valenciennes). Tarpon.

Common. The principal object of the spillway fishermen. The largest example taken here had a total length of 188 cm. and a weight of 38.5 kilograms, whilst the smallest had a length of 254 mm. Although none were taken during my stay, they were seen constantly leaping near the foot of the dam. On June 22 I again visited this place but did no collecting. The rainy season was then under way and while a thunder storm confined us to the club house, hundreds of tarpon were seen disporting themselves. So numerous were they that they literally wallowed and rolled with their backs out of water. It is

interesting in this connection to note that some San Blas Indians that were with us, taken to view the Gatun locks, were much more impressed, judging from their gesticulations by these tarpon, their favorite food fish, than by the mechanical marvels of the white men. See the general discussion preceding this list for further data on the tarpon.

5—*Elops saurus* Linnaeus. Bonyfish.
Common but not valued by the anglers. One example of 355 mm. Individuals larger than this are rare at the spillway.

Family V. ENGRAULIDAE

6—*Anchovia elongata* Meek and Hildebrand ———
Common. Five examples ranging from 68 to 74 mm. In two the pectorals reach the base of the ventrals but in the rest fall a trifle short of it.

Family VI. POECILIIDAE

7—*Poeciliopsis isthmensis* Regan. ———
One example, a young female is questionably referred to this species. Taken in company with small specimens of *Dormitator* in a very foul drainage ditch a short distance below the spillway.

Family VII. BELONIDAE

8—*Tylosurus timucu* (Walbaum). ———
Not common. One example of 272 mm.

Family VIII. ATHERINIDAE

9—*Thyrina chagresi* (Meek and Hildebrand). Needle fish.
Common and much used for bait. Seven examples ranging from 45 to 62 mm.

Family IX. MUGILIDAE

10—*Agonostomus monticola* (Bancroft). Needle fish.
Common and used for bait. Fifty-three examples, ranging from 27 to 54 mm., showed a mode of 47 mm. Apparently confused with *Thyrina* by the fishermen.

11—*Joturus pichardi* Poey. ———
Not especially common at the foot of the spillway, the local anglers having no name for it, not knowing it as a food fish. However, it is much valued by the natives. One example, a green male of 355 mm. The stomach was filled with an evil smelling black paste.

Family X. CARANGIDAE

12—*Caranx hippos* (Linnaeus). Jack.
Apparently this species appears periodically at the spillway. Its identity could not be established with certainty from the descriptions as no examples were seen.

Family XI. CENTROPOMIDAE

13—*Centropomis pectinatus* Poey. Snook.

Two small examples of 31 and 34 mm. are somewhat reservedly referred to this species. The anglers rate snook as second only to the tarpon at this place but probably refer to another species, likely *C. parallelus* Poey, that attains greater proportions, specimens up to thirty pounds being spoken of.

Family XII. LUTIANIDAE

14—*Lutianus aya* (Bloch). Red snapper.

Apparently this species is occasionally taken here, judging from descriptions of the anglers although not taken in Panama by Meek and Hildebrand '25. Examples reaching up to ten pounds were mentioned but none were seen.

Family XIII. HAEMULIDAE

15—*Pomadasys crocro* (Cuvier and Valenciennes). Bass.

Small examples common. Thirteen ranged from 25 to 65 mm. with modes at 25 and 55 mm. Those in the smaller group have the soft anal rays slightly longer than the enlarged second anal spine, but as size increases this ratio becomes inverted, the transition coming between 28 and 35 mm. This difference is to be seen with the fin erect. Larger specimens are valued by the fishermen.

Family XIV. GERRIDAE

16—*Eucinostomus californiensis* (Gill). Snook.

Small examples common. Forty examples ranging from 14 to 49 mm. showed a mode at 25 mm. while the three larger 63, 70 and 84 mm. fell without the curve. These young fish are apparently confused with young *Centropomis* by the anglers.

Family XV. CICHLIDAE

17—*Cichlasoma maculicauda* Regan. Black perch.

Common. Sometimes used for food. Three examples, 74, 88 and 102 mm.

Family XVI. TETRAODONTIDAE

18—*Spheroides testudineus* (Linnaeus). Blow-fish.

Not very common. One example of 94 mm.

Family XVII. GOBIIDAE

19—*Dormitator maculatus* (Bloch). Doby.

Common, but not in the main stream. Two examples of 39 and 41 mm. from a puddle under a leaky spigot outside the club house, and many seen in the overflow from the bait tanks. Thirteen examples from a filthy, hot and stinking drainage ditch below the spillway. These ranged from 18 to 35 mm. and showed a mode of 22 mm.

20—*Eleotris pisonis* (Gmelin). ———

Three were found at the foot of the spillway and six in a tiny spring about

a mile below. This spring forms a small, but crystal clear, pool near the edge of a banana plantation about which a small stand of native plants clusters, oasis-like, on the baked and cracked flood plain of the lower Chagres. Many small birds and one spiny tailed rat came to drink in the short time I was there. The only species of fish in the pool appeared to be the present, but there were a few individuals of a slightly larger size that I was unable to capture. Those collected ranged from 34 to 80 mm.

21—*Sicydium salvini* Grant. ————

Common at the foot of the spillway. Nine examples ranged from 24 to 30 mm. and showed a mode at 25 mm.

FISHES FROM THE RIO TAPIA

While continuing our outfitting, at Panama City, the opportunity was taken to make a small collection of fishes from the Rio Tapia at a point where the new Tapia Road crosses the river (Fig. 33). Most of the collecting was done nearly under the bridge and all within sight of it. The collection was made on February 1 and 2, mostly with a twenty foot seine, although a few specimens were taken by dip net. It is believed to represent nearly the entire fish fauna at this point. It being the dry season, the water was crystal clear and shallow. This extremely interesting section is now easily reached by automobile over the excellent new road. The list is chiefly of interest because the locality is one that has not been collected in previously and therefore is an extension of local records. The Rio Tapia is one of the few short independent streams of the Pacific slope east of the Canal, not connected with any master drainage system.

ANNOTATED LIST OF SPECIES.

Family I. CHARACIDAE

1—*Curimatus magdalenae* Steindachner.

One example of 145 mm.

2—*Compsura gorgonae* (Evermann and Goldsborough).

Ten examples of from 20 to 25 mm. In company with the more numerous *Pseudochierodon.*

3—*Pseudocheirodon affinis* Meek and Hildebrand.

Forty-three examples of from 20 to 28 mm. A specimen of either this or possibly *Compsura* was seen to be attacked by a large spider in the very swift water in which both species were disporting themselves. The attack was made while I was at extremely close range, the spider being well observed. It was

noted not to relinquish its hold on the bank with its hinder legs, simply dipping its forward parts enough to effect the capture. An inadvertent move caused it to drop its prey and allowed it to escape while the fish was rapidly swept away by the swift water, apparently quite dead, although it had only been in the spider's palps a very short time. See Gudger '25, page 263, for the full account.

4—*Gephyrocharax atricaudata* (Meek and Hildebrand).
Seven examples of from 23 to 31 mm.

5—*Astyanax ruberrimus* Eigenmann.
Eighty-nine examples of from 25 to 98 mm. Some of the larger individuals were ripe or nearly so. The dark shoulder spots so conspicuous in most of the examples subsequently taken in the Rio Chucunaque were practically absent in the present series, showing faintly in only a few. Possibly some of these should be referred to *A. fasciatus* (Cuvier) but all showed some evidences of a more or less distinct caudal spot.

6—*Roeboides occidentalis* Meek and Hildebrand.
Sixteen examples of from 62 to 139 mm. This species was seen in large schools which appeared to be made up exclusively of this form and which were not seen to mix with the equally common *Astyanax*. Numerous specimens were ripe.

7—*Ctenolucius beani* (Fowler).
One example of 175 mm. Small schools composed of individuals of about this size constantly cruised about near the surface but were exceedingly difficult to seine in the clear water on account of their leaping ability which compares not unfavorably with that of *Mugil*.

Family II. SYNBRANCHIDAE

8—*Synbranchus marmoratus* Bloch.
Three examples ranging from 88 immature to 248 mm., a spent female. Taken by seine amid the bottom debris.

Family III. POECILIIDAE

9—*Poeciliopsis elongatus* (Günther).
Two females of 21 mm. are probably referable to this species.

Family IV. CICHLIDAE

10—*Aequidens coeruleopunctatus* (Kner and Steindachner).
Three examples of from 88 to 118 mm.

Family V. GOBIIDAE

11—*Philypnus maculatus* (Günther).
Two examples of 67 and 180 mm.

Fishes from Caledonia Bay

The material and data upon which these notes are based was collected at Caledonia Bay, a small arm of the Caribbean Sea, that slightly indents the Atlantic coast of Panama near the Colombian border. See Fig. 33. As a collecting site it is of interest chiefly because of its comparative remoteness from other Atlantic coast collecting points. Porto Bello is the nearest place from which a collection has been reported (Meek and Hildebrand '23). In the other direction a much greater distance is spanned before another site of collection is found. My presence here was in a certain sense accidental, having just emerged from the Chucunaque drainage by force of necessity, after crossing the continental divide over an unspeakable trail. I was stationed at the Indian village of Caledonia for slightly more than two weeks, although all the actual collecting was done within a period of four days, May 4 to 8. Many obstacles made even this collecting of extreme difficulty, amongst which may be mentioned a dearth of preservatives and containers, most of my supplies being nearly exhausted, a lack of proper collecting gear, not being equipped for marine collecting and numerous other activities which occupied much of my time and finally the inroads of illness into my heretofore unbroken health which eventually made my withdrawal from the field imperative.

It is hoped that this fragmentary data will be of use to those who must eventually take up the much needed study of the life histories of the Caribbean fish fauna. In all cases where it was available the local appellation given the species by the Indians at Caledonia is indicated with syllabication, the spelling being purely phoenetic. Other names, representing forms not taken but of which we had fair descriptions from the natives, follow.

Shark	Nali
Sawfish	Su-coo
Ray	Ne-der-di-be
Remora	Nali-ooru
Flounder	Oo-coo-ma-dera
Any small fry	Oo-new-su

Most of the collection was taken in a twenty foot seine operated over weedy patches, just off the beaches between coral snags. Calcium carbide, intended for use in acetylene lamps was found to be excellent as a poison for rock pools in the absence of any less

expensive substance. The efficiency of this gas generating substance was found to be high if strewn rather evenly over the bottom of such pools. The effect was rapid and not infrequently the doomed fishes would leap clear of the water landing several inches back from its edge. A small amount of angling was done whilst most of the larger fishes recorded, were collected for food by the natives of the village.

The methods these Indians used in capturing fishes, which I saw during my stay at their village, have been considerably influenced by their contact with small trading sloops and schooners that barter with these people for the splendid cocoanuts that grow here in profusion and the valuable shell of the hawksbill turtle. Of course the Indians receive a ridiculously small amount of merchandise in return, but to them the machine made artifacts of civilization are indeed of great value. In this way by degrees, many of them have accumulated a considerable store of very presentable fishing tackle, that is, at least, good hooks and stout lines. As a result, much of their fishing is simply angling after our own manner, but always by hand line. A primitive sort of surf casting is occasionally indulged in. That is, a piece of coral is tied below usually two hooks and thrown bodily from shore over sandy stretches where it will not snag and is then slowly retrieved. In doing this a coil of line is thrown seaward much as sailors use a heaving line. Live bait is generally employed, most usually *Hepsetia, Sardinella* or *Anchovia* although they sometimes troll from their dug-outs for jack and barracuda with a piece of white or colored rag as a lure.

What appear to be the more truly native methods may be tabulated as follows although these also show the effects of contact with civilization.

Spear—Spearing is a common practice and the natives are naturally expert. The spear of this region generally consists of a point made from a square iron rod, obtained from some trader, along the edges of which notches have been filed to serve as barbs, a head of black palm into which the point is affixed and a shaft of some light hollow reed. No doubt originally the black palm head was shaped into a point in lieu of the iron spear.

Bow and arrow—A certain amount of fishing is done by means of a small bow and a multi-pointed arrow, with black palm points and a reed shaft. This however is more of a fluvitile implement and not especially characteristic of the coast.

Harpoon—Harpoons are constructed somewhat similar to the

spears but with the characteristically removable point to which a stout line is affixed. This point is made of a three-cornered file from which the temper has been drawn so that it may be shaped by a second one. The three flat sides are deeply grooved in such a way that the cross section is a three pointed star. Then deep notches are filled into each of the three vanes to form barbs. I do not know if the finished point is retempered. Sharks, tarpon and other large fish are the quarry of these devices.

Trap—A device which seems to be the primitive forerunner of a fish trap was found in considerable numbers near the village of Sasardi Nuevo, just south of Point Sasardi. Such a trap(Fig. 34) consists of a vertical wall of slats lashed together with vines and running out at right angles to the shore line for 200 or 300 feet, here curving around abruptly for about half a circle with a radius of about five feet. Stationed at this point in a "Cayuka" or dug-out the fisherman stands with his spear poised ready to strike at the first edible fish deflected toward him by the wall. Some of these "traps" are improved by a platform on which to stand and I was informed that they are frequently used at night by lantern light. No true traps, however, were seen in the possession of these Indians, but one of the negro cocoanut traders had a typical West Indian basket trap or "fish pot" on board.

Seine—The closest approach to a seine which I saw was a small affair used for bait catching. A piece of coarse cloth about three by four feet strung on two long poles, much like a seine but without corks or leads was operated by two men standing in a cayuka holding the extending ends of either stick, with the net placed diagonally in the water. When a school of small fish came about it was suddenly raised bringing some of them up. Its success resides chiefly in the abundance of these small bait fishes which were mostly *Anchovia*. However, the Indians that helped me operate my seine took hold with real skill, giving me the impression that they had used such gear before. This was in decided contrast to the difficulty encountered with both our own negroes and the Indians of the Pacific drainage who were very unsatisfactory as seine men.

Caledonia Bay is shored for long stretches by gentle sloping beaches of coral sand (Fig. 35) here and there interspersed with old weathered aeolian rock formations or dense stands of mangrove (Fig. 36) about which fine flocculent silt accumulates. The beaches

Fig 34 The seaward end of a Caledonia Bay native fish deflector or trap

Fig 35 A typical stretch of beach in Caledonia Bay Along such shores small fishes find shelter in weeds growing just below the tide line

Fig. 36. A typical lane through a mangrove swamp at Caledonia. Here small Tetraodonts swarm and *Anchovia* come for shelter.

Fig 37. Brackish pools just back of the beaches at Caledonia, such as this one, generally are quite barren of fish life.

are narrow, dense shrubbery and coco palms growing almost to the water edge (Fig. 37), under which are brackish pools quite barren of fishes, for the tide here is so slight as to be practically negligible. Below the tide line in many places patches of *Zostera* grows in profusion. Here the young of many species seek shelter together with the adults of the more diminutive forms. Small tide pools, formed in the aeolian rock by the slight rise and fall, harbor a variety of invertebrates and small fishes, gobies and blennies being especially abundant in such places. Just off the edges of the mangrove swamps, schools of Engraulids and Clupeids surge back and forth retreating into its shelter when danger approaches, whilst Tetraodonts of small size teem in places under these upthrust tangled mats. Between May 4 and 16 about fifty feet from shore the water temperature ranged from 84° to 89° at the surface, whilst closer it reached 91° frequently and even higher in the rock pools. The accompanying air temperature ranged from 80° to 85°.

A short distance off shore the gradual beaches take a rather abrupt drop, meeting the fantastic coral beds of the typical Caribbean variety. Here the larger fishes commonly associated with such places disported themselves. Still further off large numbers of small islands arranged in a single or multiple series parallel the coast. Some consist of a purely coral origin whilst others attaining greater heights clearly have had at least a nucleus of other genesis. These islands are much more numerous than any map shows, multitudes of tiny ones, some not over one hundred feet in diameter being scattered all about. They are variously fringed by shores similar to those found on the mainland. Fending off the force of the breakers still further seaward a typical fringing reef, just about awash, marks the shoreward approach of the open ocean. In the lanes, often of considerable depth, between the islands and between them and the reef the larger fishes roam, sharks, barracudas and so forth as well as schools of various Scombrid-like fishes.

The fish fauna, as would be expected, is typical of the Caribbean region and probably differs in no essential respect from that at Colon. As the collection is extremely small and fragmentary its variety indicates the richness of the region. In all only two rock pools were poisoned, two seining parties, one dip net party, four trolling and four angling parties, were undertaken and four native catches were examined. In addition to those species taken numerous others were seen but owing to circumstances were impossible of

capture, such as large sharks, probably *Carcharhinus*, Scombrids, probably *Scomberomorus*, Hemiramphids and numerous reef fishes more or less familiar.

A considerable paucity of small species was apparent although the shores abounded with little fishes but these were mostly the young of larger species, the only small fishes found in abundance being *Anchovia* and *Hepsetia*. The complete absence of Poeciliids was striking and in such places as they are usually found, in mangrove swamps and similar locations, young Tetraodonts swarmed. However, near the head of brackish water and above in the fresh water of the exceedingly short streams of this slope they were not uncommon although none were seen which could be considered marine.

ANNOTATED LIST OF SPECIES.

Family I. SYNBRANCHIDAE

1—*Synbranchus marmoratus* Bloch. Yar-be.

Contrary to the findings of Meek and Hildebrand '23 this species was noted to be fairly common in the fresh waters of Panama, being taken in numbers on several occasions. It is included in this list of marine fishes as a single example of 248 mm. was seined out of the sea at Caledonia. Gilbert and Starks '04 who found it common at Miraflores suggested that it burrows in the mud as they took none with their seine. Although three specimens were taken by seine in the Rio Tapia on the present expedition this secretive habit was found to be characteristic for it was only necessary to drop some effervescent substance in a sluggish creek or pond that superficially appeared to be barren of them to see them come wriggling out of their places of refuge which were usually hollows under rocks. The example taken in salt water at Caledonia showed a very evident emaciation and it is quite possible that it was washed down to the sea in a weakened condition after one of the cloud bursts of the early rainy season, since the species appears to be a typical inhabitant of the head waters, as all the other material was taken well inland, chiefly in small tributaries. Furthermore ripe examples were taken far from the sea, the species probably not being catadromus.

Family II. MURAENIDAE

2—*Gymnothorax funebris* Ranzani. Yar-be.

A single example of 234 mm. Its stomach contained the carapace of a crab 16 mm. across. The coloration was of as bright a green as I have ever seen this species show. The natives evidently confuse *Synbranchus* with this as probably they are not very familiar with the former.

3—*Echnida catenata* (Bloch). Ti Naipe.

Not uncommon, but greatly feared by the natives. Their name literally

translates to water snake. This they also apply to serpents which dwell along the water courses. One specimen of 370 mm. This example had its digestive tract crammed with the remains of small crabs, the carapaces of which averaged about 25 mm. across. These were intertwined with numerous parasitic worms. It was undeveloped sexually although Meek and Hildebrand '23 took a ripe female of not more than 120 mm. longer in April at Colon.

Family III. ELOPIDAE

4—*Tarpon atlanticus* (Cuvier and Valenciennes). Me-la.

Fairly common. Appears periodically in large schools. Valued by the Indians to the extent that it is apparently their most highly prized food fish. One large school which appeared on May 6 caused the bulk of the male population to give chase, which however was unsuccessful.

Family IV. CLUPEIDAE

5—*Sardinella macrophthalmus* (Ranzani). Sardina.

Common near the edges of mangrove swamps, in small schools of individuals up to about 230 mm., or as scattered individuals in company with the more numerous and smaller *Anchovia*. Two typical examples of 44 and 46 mm. In weedy places along sandy shores smaller examples were common in company with juvenile *Anchovia*. Four examples from 23 to 26 mm. just out of the larval stage. With these were five specimens ranging from 22 to 24 mm. which appear to be of this species but still show numerous larval characteristics. Most prominently they still have a somewhat rounded ventral outline and are more elongate. The name used by the Indians is obviously borrowed from the Spanish.

Family V. ENGRAULIDAE

6—*Anchovia brownii* (Gmelin). Oo-new-su.

Found in tremendous shoals of thousands of individuals skirting along the edges of mangrove swamps, into which they retreat on the slightest provocation only to reappear a few moments after quiet is restored. The precision and unanimity with which these schools wheel and turn is striking, reminding one of the actions of a wandering flock of European starlings. Twenty specimens of from 41 to 51 mm. with a mode of 43 mm. In grassy patches along sandy beaches, smaller sized individuals were found in more scattering schools. These were just passing out of the larval stage and ranged from 22 to 30 mm. showing a mode of 24 mm. (fifty two specimens).

Family VI. BELONIDAE

7—*Tylosurus timucu* (Walbaum). Tabu-garraty.

Small examples were common close to shore. Larger examples about 300 mm., likely of this species, were seen over greater depths. Three examples, 100 to 106 mm.

Family VII. SYNGNATHIDAE

8—*Syngnathus mackayi* (Swain and Meek). Time-mass-su.

Found amid patches of marine growth near shore. Previously not re-

corded south of Porto Bello. Two examples, 132 and 134 mm., both males.

Family VIII. ANTHERINIDAE

9—*Hepsetia stipes* (Müller and Troschel). Oo-new-su.

Abundant, fringing the shores all over. Previously Porto Bello marked the southernmost limit of its known range. The Indians apparently do not distinguish this from *Anchovia*. Twenty-three examples ranging from 29 to 46 mm. with a mode of 40 mm.

Family IX. SPHYRAENIDAE

10—*Sphyraena barracuda* (Walbaum). Da-bu.

Common along sandy beaches, especially the very young, which roamed around near the edges of weedy patches generally. Very large examples of this and possibly other species cruised about in the deeper water between the fringing reefs and keys more offshore. Whilst we were not equipped for collecting such material, trolling spoons were contrived by Mr. Marsh to the number of six or eight. Although supplied with heavy wire leaders they were all lost at the first strike of these fish, such was their force, some of which were much over 125 cm. The most numerous ranged between about 30 and 90 cm. Nine examples ranging from 47 to 71 mm. with a mode of 55 mm.

Family X. HOLOCENTRIDAE

11—*Holocentrus ascensionis* (Osbeck). Oo-ah-dar-see.

Common, the very small often in company with *Upeneus*, young Haemulids, et cetera. Five examples, one of 55 mm. and four of about 153 mm. each, the former from a weedy patch and the latter by hook and line about coral heads.

Family XI. MULLIDAE

12—*Upeneus maculatus* (Bloch). Se-no-oo-ah.

Very common about weedy patches. Nine examples ranging from 48 to 75 mm. with a mode of 55 mm.

Family XII. CARANGIDAE

13—*Caranx ruber* (Bloch). ———

One example of about 300 mm. was taken by Mr. Charles Charlton on a trolling spoon intended for barracuda. Many of this or closely similar species were seen, all well offshore, mostly in the lanes between the islands. This species appears not to have been recorded south of Cozumel.

14—*Caranx crysos* (Mitchill). Ca-lu.

Fourteen small carangins, taken near weed patches, which range from 38 to 65 mm. and show a mode of 42 mm. are somewhat questionably referred to this species, as they show numerous small differences from the adult descriptions of this well known form.

Family XIII. SERRANIDAE

15—*Cephalopholis fulvus* (Linnaeus) Marga-too-go-willy.

One example of 103 mm.

16—*Epinephelus morio* (Cuvier and Valenciennes). ————
Not uncommon, but not nearly as abundant as *E. striatus.*

17—*Epinephelus adscensionis* (Osbeck). Marga-too-go-willy.
Not uncommon. Apparently not distinguished from *Cephalopholis* by the natives.

18—*Epinephelus striatus* (Bloch). ————
Thirteen examples ranging from 150 to 610 mm.

19—*Epinephelus guttatus* (Linnaeus). Too-goo.
Eight examples ranging from 125 to 254 mm. Generally in company with *E. striatus* near reef formations.

Family XIV. LUTIANIDAE

20—*Lutianus synagris* (Linnaeus). Oo-ah-nalu.
One example of 110 mm.

21—*Lutianus jocu* (Bloch and Schneider). Nalu-oo-sele.
Not uncommon. One example of 235 mm. was apparently immature and contained a single small crab in its stomach.

22—*Lutianus apodus* (Walbaum). Nalu-oo-sele.
Fairly common. Two examples of 150 and 343 mm. The latter, a nearly ripe female had a fish sound in its stomach whilst the former was immature. Naturally this is not distinguished from *L. jocu* by the natives.

23—*Lutianus ambiguus* (Poey). ————
One specimen of 100 mm. which considering its small size agrees well with the descriptions of this little known form.

24—*Ocyurus chrysurus* (Bloch). Yala-tail-a.
Not uncommon. The Indian name is obviously a corruption of the English West Indian name "Yellow tail." A favorite food fish of the natives.

Family XV. HAEMULIDAE

25—*Bathysoma rimator* (Jordan and Swain). Oo-ah-su.
One example of 103 mm.

26—*Haemulon flavolineatum* (Desmarest). ————
Seven examples of 101 to 152 mm. Twenty-three small Haemulids ranging from 22 to 35 mm. with a mode of 27 mm. are questionably referred to this species. The agreement is fair but the coloration and pattern is considerably different. These were taken in weedy places close to shore.

27—*Haemulon sciurus* (Shaw). Bu-too.
Not uncommon. Generally found in company with *H. flavolineatum.*

28—*Anisotremus surinamensis* (Bloch). Wati-car-see-che.
A single medium sized specimen was seen.

Family XVI. GERRIDAE

29—*Eucinostomus californiensis* (Gill). ———

Small examples were found chiefly in weedy places and occasionally off the coral island opposite Caledonia village. One group of eight specimens ranged from 25 to 39 mm. and showed a mode of 25 mm. and another of seventeen specimens ranged from 12 to 20 mm. and showed a mode of 14 mm.

Family XVII. POMACENTRIDAE

30—*Abudefduf saxatilis* (Linnaeus). Canis-ah-oo-wa. Young Qua-beb.

Fairly common about snags and coral heads. Young common in rock pools. Here they tend to school and keep more to the open places than the *Pomacentrus* there associated with them. The coloration of these was very pale in life, much less so than examples of similar size seen in Bermuda. They were somewhat reminiscent of *Cyprinodon variegatus* Lacépède in appearance and action. Twelve examples ranging from 12 to 29 mm. showed a mode of 17 mm.

31—*Pomacentrus fuscus* Cuvier and Valenciennes. Was-che-che.

Common in tide pools. Three examples of from 15 to 45 mm.

Family XVIII. LABRIDAE

32—*Doratonotus decoris* Evermann and Marsh. Ah-bu.

Two specimens (32 and 40 mm.) of this exquisite little bright green labrid were seined from a patch of weed on a sandy beach. The apparent irregular boundary of the dorsal, the completely transparent nature of the distal margins of the vertical fins, the entire transparence of the pectorals and the full coloration of the ventrals gave them in life, an extremely broken outline (Fig. 38),

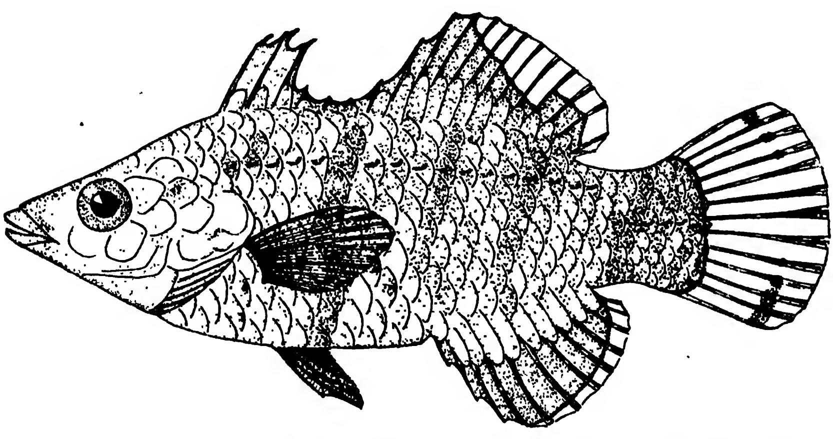


Fig. 38. *Doratonotus decoris.* A sketch of the larger example, showing the unusually broken and abrupt outline of the coloration extending on the vertical fins, beyond which they are nearly invisible in life.

so that they greatly resembled torn fragments of sea weed. As they swam in the collecting pail, after the manner of their family, slowly winging their way along by means of their pectorals alone, which were perfectly invisible, and steering by their nearly equally invisible caudal, the illusion was greatly enhanced and were it not for their irregular and erratic gyrations I might not have recognized them as fish. Even when lifted in the hand the sense of touch was called in to supplement that of vision in definitely establishing the presence of the tail fin. Unfortunately much of this transparence has vanished in spirits. Examples from other localities do not always show this extremely irregular outline of color, there being apparently much variation in this character. Both of the present examples were ripe females. The ovarian eggs average 0.30 mm. in diameter. The abdomens were considerably distended. This is the southernmost record for the species.

Family XIX. SCARIDAE

33—*Sparisoma hoplomystax* (Cope). Ah-oo.

Two examples of 70 and 350 mm. The former may possibly be *S. niphobles* Jordan and Bollman which closely resembles this species and is almost impossible to differentiate at this size owing to the inconstancy of the differential characters.

34—*Scarus croicensis* (Bloch). Ah-oo.

Three examples ranging from 14 to 35 mm. They lack the characteristic light abdominal streak but otherwise the agreement is good considering their small size.

Family XX. CHAETODONTIDAE

35—*Pomacanthus arcuatus* (Linnaeus). Oo-ha-sigel-de.

Common about coral heads in company with what appeared to be *Angelichthys* as near as could be told without the aid of a water glass. One example of 80 mm.

Family XXI. TEUTHIDAE

36—*Teuthis bahianus* (Castelnau). Oo-ah-nali.

Seven examples ranging from 31 to 46 mm. with a mode of 33 mm. All near weed patches. Although showing numerous immature non-diagnostic characters they are referred to this species because of the shape of the tail even though it lacks the filament often found in the adults, the light margining of that fin which was blue in life and the body depth which increases from 1.7 in the smallest to nearly 2.0 in the largest.

Family XXII. BALISTIDAE

37—*Balistes vetula* Linnaeus. Old-wipe.

Three examples of from 101 to 203 mm. Common about coral heads. The Indian name is clearly a corruption of the English West Indian name "Old wife."

Family XXIII. MONACANTHIDAE

38—*Monacanthus ciliatus* (Mitchill).

Two examples of 31 and 42 mm. In weed patches near shore. In life numerous dermal flaps were prominently scattered over the sides which together with the general greenish coloration appears to attain nearly the same degree of deceptiveness that *Doratonotus* does by other means. Both these species living side by side and normally of slow movements greatly resemble fragments of sea weed to the human eye at least. This seems to be a case of parallel development induced by similar needs of protective resemblance for such it certainly appears to be, one meeting the requirements of the adults of a small species and the other those of the young of a larger one that loses it later.

39—*Alutera scripta* (Osbeck).

One example of 301 mm.

Family XXIV. OSTRACIIDAE

40—*Lactophrys bicaudalis* (Linnaeus). Cala-pa-too

One example of 381 mm.

Family XXV. TETRAODONTIDAE

41—*Spheroides testudineus* (Linnaeus). No-sardele.

Common in mangrove swamps, particularly where fresh waters are emptying out, but all small. See Fig. 36. Here they "poke" about slowly, apparently feeding on small invertebrates attached to the roots and stalks of the mangrove trees. Occasionally about the shores of coral islands. Two examples 14 and 51 mm.

Family XXVI. GOBIIDAE

42—*Gobius soporator* Cuvier and Valenciennes. Too-goo.

Common in tide pools. Twenty examples of from 16 to 71 mm. showed modes at 20, 45 and 65 mm.

Family XXVII. BLENNIIDAE

43—*Labrisomus nuchipinnis* (Quoy and Gaimard). ———

One example of 21 mm. from a rock pool. Only one opercule showed the characteristic spot.

44—*Blennius cristatus* Linnaeus. Too-wala-lady.

One example of 36 mm. In company with *Gobius*.

45—*Salariichthys textilis* (Quoy and Gaimard). Too-wala-lady.

One example of 31 mm. In company with *Gobius* and *Blennius*. Naturally the Indians do not have separate names for these small fishes that are not of use to them.

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No. 5 of Vol. 4 missing

Index

ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

INDEX TO

VOLUME V

DECEMBER 1923–1925 MARCH

NUMBERS 1–21 INCLUSIVE

PUBLISHED BY THE SOCIETY
THE ZOOLOGICAL PARK, NEW YORK

1927

ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

DEPARTMENT OF TROPICAL RESEARCH
WILLIAMS GALAPAGOS EXPEDITION

VOLUME V, NUMBER 1

Department of Tropical Research, Contribution Number 151

WILLIAMS GALAPAGOS EXPEDITION

BY WILLIAM BEEBE

Director, Department of Tropical Research and Honorary Curator of Birds New York Zoological Society

PUBLISHED BY THE SOCIETY
THE ZOOLOGICAL PARK, NEW YORK

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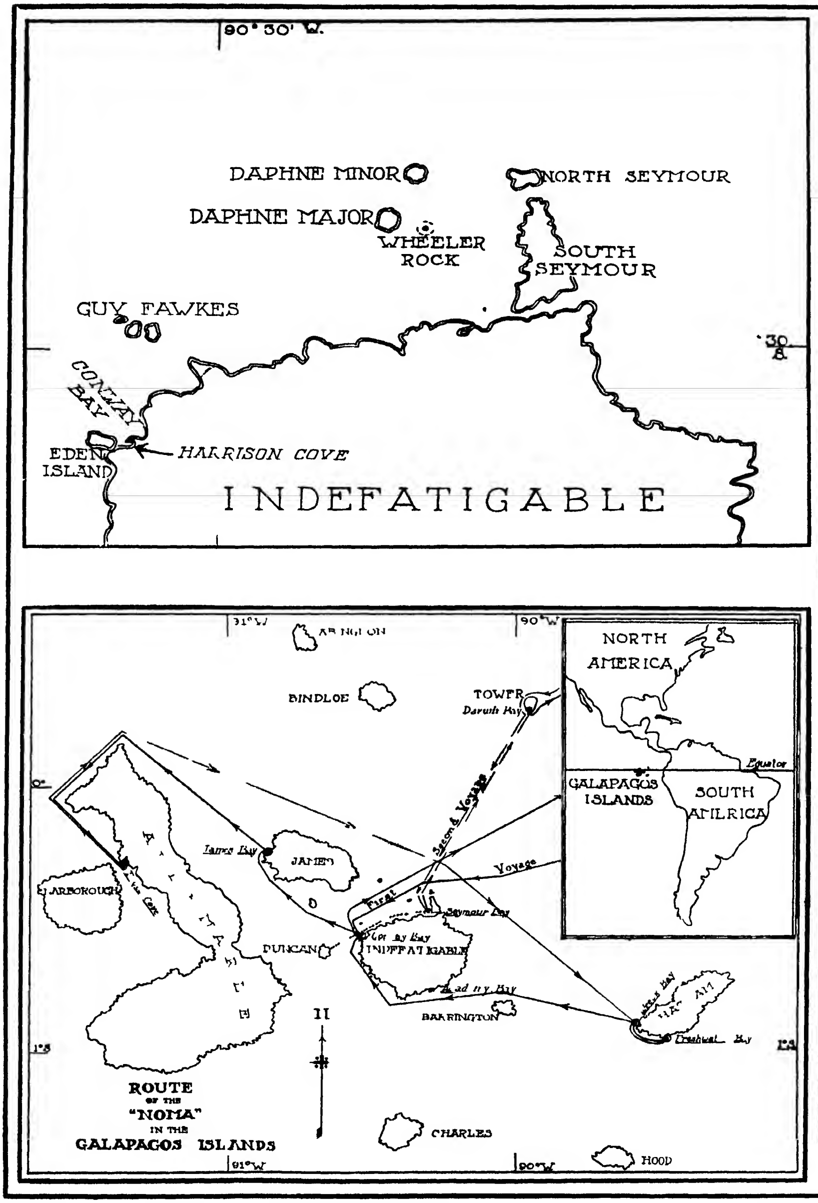

Plate A. SKETCH MAP OF GALAPAGOS ISLANDS

Route of the *Noma*, and details and location of the Archipelago.

First form on press December 31 1923

WILLIAMS GALAPAGOS EXPEDITION

By William Beebe

Director, Department of Tropical Research, and Honorory Curator of Birds
New York Zoological Society

Photographs by the Author and John Tee-Van

I. Resume

This expedition, to one of the least visited corners of the earth, was conceived and achieved in record time, every hope was consummated, every expectation realized. First and last, the credit belongs to Harrison Williams, Esq., who initiated and financed the whole trip, and then to the twelve members of my party, who made possible all that we accomplished during the limited time at our disposal.

We left New York on the steam yacht *Noma* on March 1, and returned on May 16. This was just in time to rush the collections of live mammals, birds and reptiles to the Zoological Park, and to frame and hang for exhibition the one hundred and thirty oil paintings and water colors made during the trip, in readiness for the Annual Garden Party of the Zoological Society on May 17.

During the trip we steamed a total distance of nine thousand miles, and crossed the equator eight times. Twenty-one memorable days were spent on the Galapagos Islands, and we touched besides at Charleston, Key West, Havana, Colon and Panama.

To the living collections of the Zoological Park were added the following, most of which were new to the collections, some being exhibited for the first time anywhere in the world:

Mammals.—5 monkeys, 3 opossums.

Birds.—3 penguins, 2 flightless cormorants, 3 gulls, 3 doves, 1 hawk, 10 parrakeets, 2 jays, 3 mockingbirds.

Reptiles.—42 lizards.

For the American Museum there was collected material for two lizard groups, including vegetation, rocks, shells, sand and many photographs, together with a giant tortoise, eighteen lizards and a family of sea-lions.

FIG 1 A ROUGH DAY AT SEA

All work ceased when we rolled in the great troughs It was a glorious sight to sit in the stern and watch the emerald combers seething over the rail

Photograph by William Beebe

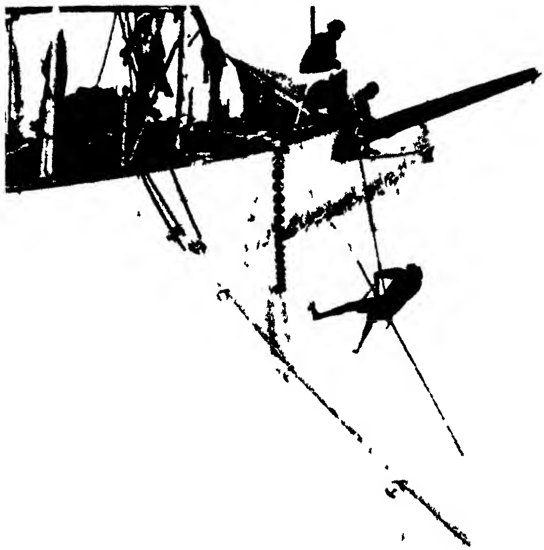

FIG. 2 FISHING FROM A BOWSPRIT
Strange fish, worms, jellies and even insects can be caught from this swinging seat, at full speed and in rough weather

For study by the department of Tropical Research of the Zoological Society:

90 water color plates by Miss Cooper.
40 oil paintings by Harry Hoffman.
46 pen and ink drawings by Mr. Broking.
400 photographs and 11,000 feet of moving picture film by Mr. Tee-Van.
160 bird skins.
Many nests and eggs.
150 reptiles.
200 fish.
3,000 insects.
40 jars of specimens.
60 vials and jars of plankton.
200 microscopic slides of plankton.
100 specimens of plants.
300 pages of narrative, records, notes and catalogues by Miss Rose.

FIG 3 DARWIN BAY TOWER ISLAND

A sheltered mile wide bay which seems never to have been described or mapped Every niche of cliff every bush and shrub holds nests of gulls terns boobies doves or frigate birds

This material is remarkable both for its rarity, excellent preservation and for the fact that it was almost all collected within a period of three weeks. The various groups of organisms will be studied by members of the expedition or sent to specialists, and the results published in the following numbers of Zoologica, while the more general matter has appeared in a volume by William Beebe, called "Galapagos; World's End," published under the auspices of the Zoological Society, by George P. Putnam's Sons.

II. Brief Narrative

The *Noma*, with all the members of the Williams Galapagos Expedition, steamed from her berth in Brooklyn at noon on March 1, but swinging the compass and engine adjustment kept us in the lower bay for thirty hours. This gave opportunity for unpacking and storing our vast quantity of paraphernalia, and in fitting up a laboratory, a fortunate interlude as it proved, for the passage down the coast was rough and stormy. Scientific work on a yacht under way was a new experience to me, and we ran the gamut from comfort to absolute cessation of work. Until we learned to fasten everything down, a sudden terrific heave would sweep the laboratory tables quite clean, and on unusually rough days we would continue our work seated on the floor, as chairs were useless. This was the exception, however, and in the usual calm weather, the twenty-five hundred horse-power, twin-screw engines gave forth not a tremor or vibration so that even high power microscopic research could be carried on.

By the time we were off the Florida coast the sea permitted me to occupy my usual perch in a boatswain's seat, over the bow, close to the water, where, with a long-handled net, I secured sufficient fish and sea-weed fauna for days of study. We put into Key West to pick up Dr. James Mitchell and to obtain additional supplies of coal and water, and then crossed to Havana for a supply of 95 per cent. alcohol for the preservation of our specimens. While in port we dredged sand bars, and caught sharks and various tropical fish from the rail.

From the Windward Passage between Cuba and Haiti, to Colon, we were in the trough of a heavy sea, and rolled steadily, occasionally as much as 34 degrees. At Colon we were overhauled and coaled, giving time for collecting trips to the jungle and coast beyond Fort Sherman, for horseback rides to the Chagres River,

FIG 4 LAND LIZARDS OF THE GALAPAGOS

On the sandy upland veldt of Seymour Island we caught these great iguanas red and green, yellow and ivory white—as eager to bite as their fellows of the surf were innocuous

tarpon fishing at the Gatun spillway, and trips back and forth across the Isthmus. In Colon we met with the greatest disappointment of the voyage as Mr. Williams was compelled, for business reasons, to return to New York. It was with the deepest regret that we saw him go, for his enthusiasm in the expedition had been great, and now the real excitement of exploration was just ahead.

For a supply of fresh water beyond that which the *Noma* carried, we depended upon the islands, as a supply was marked on the chart in several places, and the pilot book mentioned even a pipeline on the dock at Chatham. We passed through the Canal without special incident, arriving at the Panama end in time to see the final searchlight display of the combined Atlantic and Pacific fleets. On the night of March 24 we steamed into the Pacific, which was as smooth as a lake during the four days it took us to reach the Archipelago. Indeed during our time there and on our voyages to and from Panama this ocean lived up to its name, and we experienced only perfect weather and summer calm, a welcome change from our Atlantic memories.

FIG. 5. A FEARLESS SEA-LION

Like the birds in the background this big male seal had probably never seen a human being and could conceive no harm as coming from such a strange creature

At dawn on March 28 we sighted the islands, and steaming slowly among their misty shapes, recognized Indefatigable, James, Seymour, Daphne, Jervis and Duncan, and dropped anchor about 10:00 A. M. in Conway Bay on the north-west side of Indefatigable. This anchorage, chosen more or less at hazard because of our incomplete information concerning the islands, proved to be a fortunate choice. Sheltered on the west by Eden, an isolated volcanic peak of an island, a sandy beach at the back of a natural lava breakwater provided an easy and safe landing for our small boats. Here we pitched two tents for temporary laboratories, though most of our work in arranging and studying specimens continued to be done on board ship. During our entire stay at the islands we lived on the *Noma*, thus eliminating the extra work of transporting supplies; also we had the benefit of the evening breezes and escaped the mosquitos which on some of the islands appeared at dusk in innumerable swarms.

FIG 6. THE LAVA SLOPES OF EDEN

Home of the great sea lizards At low tide they clamber down over the barren cliffs to feed on tufts of seaweed Indefatigable in the distance

The shore life at this landing, which we named Harrison Cove, was plentiful and most interesting. The instantaneously arresting feature was the astounding tameness of all the creatures. Having never seen human beings they had little fear, the birds and sea-lions being particularly indifferent to us. Perhaps indifference is hardly the word, since in many cases they showed great curiosity about us. Mockingbirds would follow us along, hopping from branch to branch within arm's reach; little flycatchers would perch a foot from our faces, in close inspection of our mystifying presences. It was found almost impossible to alarm some of the big pelicans or gulls and even among the crabs some individuals would stand as quietly as the lava while we touched or pushed them about. During our first hour ashore a wild duck flew down and alighted at our very feet and a short-eared owl perched on my helmet as I walked through the low scrubby undergrowth.

Our first day at Harrison Cove was rich in interest and no one of our succeeding days fell below its high standard. The fact that a large percentage of the fauna and flora of the Galapagos is peculiar to this Archipelago, and the presence of such rare forms as Amblyrhynchus, the only marine lizard in the world, and Conolophus, an extraordinary land lizard whose numbers are rapidly decreasing, makes the study of these islands of particular interest.

At Conway Bay we had a wide field from which to choose. Eden, in spite of its small size, yielded a great quantity and variety of specimens. It was here in one small cove that I obtained our collection of living Amblyrhynchus, and a host of interesting facts concerning their life history. Insects on the Galapagos are very limited as to numbers as well as species, but some unusual ones were collected here, while tide-pools among the lava shore were inexhaustible mines of beauty and value. Guy Fawkes Rocks to the northeast of our anchorage were favorite haunts of sea-lions and many memorable hours were spent under the over-hanging cliffs in photographing these animals and in delightful tests of their tameness. Later, specimens were secured here.

We had not found fresh water at Conway Bay and our supply was rapidly diminishing. Even now we were on rations, shaving in Whiterock or Poland Water and bathing only in salt water. According to the chart, there was fresh water at James Bay on James Island, not far to the north of Indefatigable, and four of the party went off in one of the larger motor-boats to investigate. They

FIG. 7 TAGUS COVE, ALBEMARLE

The yacht *Noma* in the haunts of the Flightless Cormorant. The bird sits on its nest without fear, seeing for the first time human beings. This individual is at present living in the New York Zoological Park.

returned late the same night, reporting that they had found no water but giving such glowing accounts of the island that we determined to stop there if only for a short time on our way to some other spot in search of water.

At noon on April 4 we anchored at James Island where eighty-eight years ago Charles Darwin had spent a week. In James Bay we hurried ashore in small boats. The landing was a difficult one in spite of a long sandy beach, for the surf was very heavy and a bad undertow combined with swirling cross currents made it a risky spot. This island differed from Indefatigable in that trees of considerable size grew close to the shore, which made it possible with slight effort to reach the forested slopes of the crater. On Indefatigable we had not been able, in the limited time at our disposal, to penetrate the miles of country, covered with jagged broken lava, cactus and thorny scrub, which separated the semi-arid coast from the forested high country of the interior. On James the going was also made comparatively easy by the well-defined donkey trails. Each of the larger islands that we visited seemed to have some sort of animal, once domestic, which had bred and multiplied and reverted to a wild state. Indefatigable, for instance, has its wild dogs; South Seymour its flocks of wild goats; Albemarle its cattle, and James, judging from the number and well-worn condition of the trails, is the home of large numbers of wild donkeys. Here we also found the skeletons and tracks of wild pig and one of our number shot a large sow. Whether these animals were left here by buccaneers or whalers as a future food supply, or whether they are the only survivors of ship-wrecks of long ago, no one knows.

It is an interesting fact that these imported forms, all of which we are accustomed to consider as thoroughly tame, should here, after a few generations of non-domestication, be the only really wild animals. They have reverted to a completely feral state, that is to say, of fear of man, while such creatures as birds or reptiles from which we expect no confidence, are, in these islands, tamer than barnyard fowls. On Indefatigable one glimpse of wild dogs was vouchsafed to me, wolfish looking animals who, on sight, snarled and slunk away.

During our few hours at James Bay we saw only two donkeys, one of which was pure white, though the hills often reverberated to their hearty braying, and the one wild pig was secured only after a stalking as cautious as though a deer had been the object of the

chase. The contrast is great between this sort of pursuit and our experiences in lifting up frigate birds and cormorants from their nests, and patting sea-lions on the head.

We found no fresh water on James, only brackish pools close to the sea, where ducks and herons were plentiful. Here, too, we saw flamingos passing overhead, but there were few seabirds, as the closely wooded shores and absence of islets offered no attraction to them. The water question was sufficiently pressing to prevent us from spending more than one day here, and it was decided to steam for Tagus Cove on Albemarle, which was marked on the chart as a good anchorage, with two places on the shore where fresh water could be obtained.

In returning to the *Noma* that evening, three of our party had a narrow escape from what might have been serious injury. In launching the small motor boat, it was overturned by a big breaker and they had a bad few minutes in the surf. Luckily they escaped with nothing worse than a few cuts and bruises. The boat was smashed and rifles and personal belongings were lost. Later in the evening when their predicament was discovered they were brought off in a lifeboat.

Early next morning we left for Tagus Cove, steaming around the north end of Albemarle and passing between it and Narborough. On these two islands we saw what seemed like the most recent evidences of volcanic activity, great black swathes of lava slashing across the green of trees and undergrowth. It became noticeably colder in passing to the west of Albemarle on the open ocean side, so much so that sweaters were comfortable for an hour or two. At first we were doubtful of the identity of Tagus Cove, it seemed so small and unlike in shape to that anchorage shown on the chart. But once inside, a more perfect shelter would be hard to conceive. Long and narrow, between straight towering cliffs, with deep water up to within a few feet of land, it was a satisfactory and a wonderfully picturesque anchorage. The landing facilities left much to be desired, but that was of small moment compared to our disappointment when the chart was once more proved to be over-optimistic on the subject of water. Not a drop of the precious fluid was to be found, although this was the height of the rainy season, and our only hope now was to go to Chatham, in search of that pipeline of which the pilot book spoke so glibly.

We calculated that with our shortage of supplies it would not be advisable to stay long at Tagus Cove, but our few hours there yielded a rich harvest. Some of the party explored the slopes adjacent to the Cove, finding quantities of nests and eggs of the black finches (Geospiza), and other indigenous birds, besides insects, lizards and botanical specimens. Others climbed the steep cliffs around the Cove, carrying with them, by enormous exertion, motion-picture and other cameras, plates and equipment up the almost perpendicular slopes. In this Cove we secured live penguins and flightless cormorants, as well as the nests and eggs of the latter. Boobies, pelicans and terns were abundant and nesting.

We left Tagus and steamed toward Chatham, crossing the equator four times in twenty-six hours. Early the next morning we anchored at Wreck Bay which boasts the only lighthouse in the Archipelago, visible for four miles, which is not bad for a gasoline light on a long pole. Nothing else is to be seen of human occupancy in this Bay except a square white shack where the lighthouse keeper lives, and a very shaky pier. The pipeline of the pilot book did not exist. The lighthouse keeper, an Ecuadorian who said he was also Captain of the Port, came aboard with an old Englishman, and we were told that the only way to obtain fresh water was to have it brought in casks on the back of oxen from a distance of five miles up in the mountains. As we needed forty tons of water, this was an impossible way of obtaining it, and the prospect was very gloomy. The old Englishman who told us he was "Johnson of London" and who had lived so long in Wreck Bay that he had almost forgotten his native tongue, volunteered to pilot us around the island to Fresh Water Bay where he was sure we could get a sufficient supply. So, having stopped hardly long enough to anchor, we got under way again, and cruised around to the Bay with the promising name.

Here we found two cascades of fresh water, one of good size, which plunged over high cliffs and poured into the sea. Against the foot of the cliffs surged a tremendous surf, which kept all small boats a hundred feet off shore. The Bay was such only by courtesy, for there was almost no incurve to the forbidding coast line and it was on the weather side of the island. There was no bottom a quarter mile off shore, and the Captain dared approach no closer. So we watched the tantalizing spectacle of quantities of fresh water running to waste in a spot which for us was utterly inaccessible.

FIG. 9. SEYMOUR ISLAND

Where hawks are so tame that one may walk around them and choose a suitable background

lope in corresponding places in Africa. This, too, was the only place where we found Conolophus, the giant land lizards.

Daphne Major, five miles to the north, was visited twice. It is a perfect island crater, and after landing on its most inhospitable cliffs, we climbed its precipitous sides covered with loose, easily-sliding shale and looked down into the deep crater. The floor covered with white sand was dotted everywhere with hundreds of nesting boobies, all of the blue-footed species. We went down and walked about among them, collecting a chick, or an egg or an adult here and there, and taking photographs at close range without causing more disturbance among them than an occasional gurgling protest. Except for one dead pelican we saw no other kind of sea-bird on the floor of the crater, though on the outside slopes were numbers of nesting tropic-birds, terns, Creagrus and Galapagos gulls.

In all our wanderings we had seen no tortoise nor traces of one anywhere, although not so many years ago they were probably the most usual sight on the islands. The whaling ships used to carry them away by the hundred to provide a welcome change of diet on long voyages. Oil hunters from the mainland have made great inroads on their numbers and wild dogs and pigs have probably accounted for numberless eggs and newly-hatched young. Where the tortoises are not actually extinct, the survivors have evidently betaken themselves to the craters of the interior. In 1907 it was reported that these reptiles were most numerous on Duncan, so five members of the expedition went to Duncan in a large motor boat, thirty-six miles away, hoping to verify this report. They beat over the land near the shore and much of the interior of the lesser crater and found only one moderately large tortoise, which, after the most exhausting labor, they managed to carry back to the boat. It seems certain that another unique form of life is well on the road to extinction, thanks to the efforts of man.

Our last anchorage in the Archipelago was at Tower Island, in Darwin Bay, a hitherto unmapped bay which we discovered and named. The bay is over a mile square, with deep water up to the very foot of the high cliffs with which it is surrounded. Our one landing beach was extraordinarily beautiful and interesting, fronting a nesting place for hundreds of frigate-birds, boobies, gulls, doves and other native birds, as tame as we had come to expect all the creatures of these islands to be. Here were also deep pools and

FIG 10 THE ISLAND OF INDEFATIGABLE

Twenty-five miles across reaching an altitude of 2300 feet with dozens of craters, the center of this island is wholly unexplored Where buccaneers once buried their treasures, wild dogs now roam—waifs from many wrecks

wave-made wells in the rocky lava coast where inconceivably brilliant parrot and angel-fish swam in crystal clear water, and tiny sheltered sandy coves where families of sea-lions basked and played. Here we spent four unforgettable days, working from dawn to dusk to learn all we could of the life of this no-man's-land.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

DEPARTMENT OF TROPICAL RESEARCH
WILLIAMS GALAPAGOS EXPEDITION

VOLUME V. NUMBER 2

Department of Tropical Research, Contribution Number 152

GALAPAGOS HETEROCERA

WITH DESCRIPTIONS OF NEW SPECIES

By W. SCHAUS

Honorary Assistant Curator, United States National Museum

PUBLISHED BY THE SOCIETY
THE ZOOLOGICAL PARK, NEW YORK

December 31, 1923

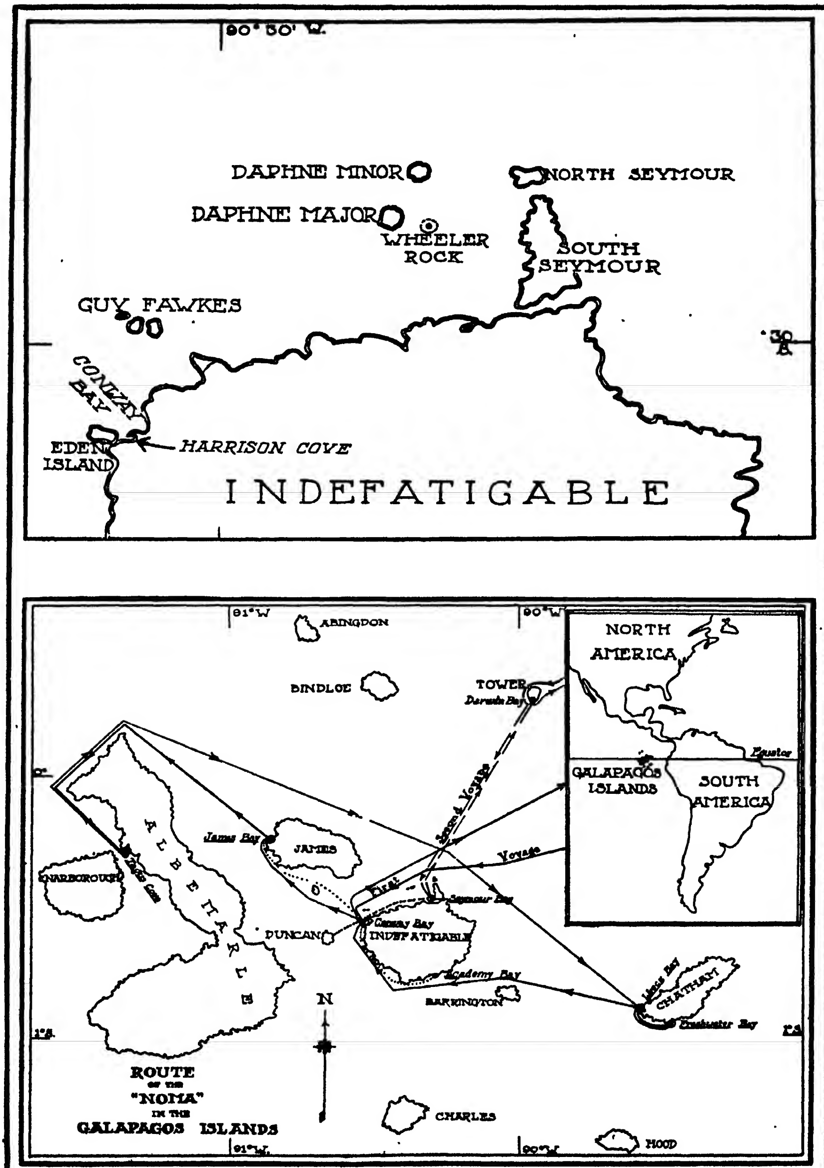

Plate A. SKETCH MAP OF GALAPAGOS ISLANDS

Route of the *Noma*, and details and location of the Archipelago.

First form on press December 31, 1923.

GALAPAGOS HETEROCERA

WITH DESCRIPTION OF NEW SPECIES

BY W. SCHAUS

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This collection of Heterocera was made by William Beebe in the Galapagos Archipelago, during the period of March 28th to April 9th, and April 19th to 29th, 1923.

The opportunity was afforded by the Williams Galapagos Expedition of the New York Zoological Society. The types of new species have been deposited in the collections of the United States National Museum in Washington, D.C.

Family ARCTIIDAE

Utetheisa ornatrix Linn.

Syst. Nat. I. p. 511 (1758)

Conway Bay, Indefatigable	13	April 1st.
Tagus Cove, Albemarle	1	April 6th.

Utetheisa galapagensis Wallgrn.

Wien. Ent. Mon. IV. p. 161 (1860)

South Seymour	7	April 23rd.
Tagus Cove, Albemarle	1	April 6th.

Family NOCTUIDAE

Subfamily AGROTINAE

Chloridea cystiphora Wallgrn.

Anthoecia cystiphora Wallgrn. *Wien. Ent. Mon.* IV. *p.* 172 (1860)
Anthoecia inflata Wallgrn. *Wien. Ent. Mon.* IV. *p.* 172 (1860)
Anthoecia onca Wallgrn. *Wien. Ent. Mon.* IV. *p.* 172 (1860)

Conway Bay, Indefatigable	15 ♂	13 ♀	April 1st.
James Island	3 ♂	5 ♀	April 7th.
Tagus Cove, Albemarle	5 ♂	1 ♀	April 6th.

Chatham Island	3 ♂	1 ♀	April 7th.
South Seymour	14 ♂	17 ♀	April 23rd.

Chloridea virescens Fabr.

Spec. Ins. II. p. 216 (1781)
Phalaena rhexia Smith and Abb. *Ins. Georgia,* II. p. 199 Pl. 100 (1792)

Chatham Island	1		April 7th.

Euxoa williamsi sp. nov.

Conway Bay, Indefatigable	8 ♀		April 1st.
James Island	1 ♀		April 5th.
Tagus Cove, Albemarle	1 ♂		April 6th.
South Seymour	1 ♂	6 ♀	April 23rd.

Lycophotia oceanica sp. nov.

Conway Bay, Indefatigable	1 ♀		April 1st.
Tagus Cove, Albemarle	1 ♂		April 6th.
South Seymour	1 ♂		April 23rd.

Subfamily Hadeninae

Cirphis cooperi sp. nov.

Conway Bay, Indefatigable	1 ♀		April 1st.

Subfamily Acronyctinae

Magusa orbifera Walk.
Cat. Lep. B. M. XI. p. 761 (1857)

Tagus Cove, Albemarle	1 ♀		April 6th.

Trachea roseae sp. nov.

Conway Bay, Indefatigable	1 ♂		April 1st.

Perigea apameoides Guen.
Noct. I. p. 229 (1852)

James Island	1 ♂		April 5th.

Perigea ruthae sp. nov.

Conway Bay, Indefatigable	1 ♂	2 ♀	April 1st.

James Island	1 ♂	5 ♀	April 5th.
Tagus Cove, Albemarle	3 ♂	1 ♀	April 6th.
South Seymour	1 ♀		April 23rd.

Perigea ebba sp. nov.

Conway Bay, Indefatigable	1 ♀		April 1st.
James Island	1 ♂		April 5th.
South Seymour	1 ♀		April 23rd.

Laphygma frugiperda Sm.-Abb.

Ins. Georgia. II. p. 191. pl. 96 (1797)

Conway Bay, Indefatigable	3 ♀		April 1st.

Catabena sp.? too poor to identify.

Tower Island	1 ♀		April 23rd.

Harrisonia williamsi sp. nov.

South Seymour	3 ♂.	13 ♀	April 23rd.

Subfamily ERASTRIINAE

Amyna insularum sp. nov.

Conway Bay, Indefatigable	18 ♂	34 ♀	April 1st.
James Island	5 ♂	8 ♀	April 5th.
Tagus Cove, Albemarle	2 ♂	2 ♀	April 6th.
Chatham Island	1 ♂	2 ♀	April 7th.
South Seymour	5 ♂	9 ♀	April 23rd.

Heliocontia margana Fabr.

Ent. Syst. III. 2. p. 257 (1794)

Conway Bay, Indefatigable	2 ♂	3 ♀	April 1st.
South Seymour	1 ♂	4 ♀	April 23rd.

Spragueia creton sp. nov.

Tower Island	1 ♂	1 ♀	April 28th.
South Seymour	1 ♂		April 23rd.

Spragueia plumbeata sp. nov.

Conway Bay, Indefatigable	1 ♀		April 1st.

Subfamily Euteliinae

Paectes indefatigabilis sp. nov.

Conway Bay, Indefatigable	11 ♂	19 ♀	April 1st.
South Seymour	2 ♂	2 ♀	April 23rd.

Paectes isabel sp. nov.

Conway Bay, Indefatigable	1 ♂		April 1st.

Subfamily Sarrothripinae

Characoma nilotica Rogenh.

Rogenhofer Verh. Zool. bot. Ges. Wien. 1881. p. 26th

Chatham Island	1 ♀		April 7th.

Subfamily Catocalinae

Mocis repanda Fabr.

Ent. Syst. III. 2. p. 49 (1794)

Conway Bay, Indefatigable	1 ♂		April 1st.
South Seymour	1 ♂		April 23rd.

Mocis incurvalis sp. nov.

Conway Bay, Indefatigable	1 ♂		April 1st.
South Seymour	1 ♀		April 23rd.

Subfamily Phytometrinae

Phytometra oo Cram.

Pap. Exot. IV. p. 45. pl. 311. f. E. (1782)

Conway Bay, Indefatigable	3 ♂	6 ♀	April 1st.
James Island	6 ♂	2 ♀	April 5th.
Chatham Island	1 ♂	6 ♀	April 7th.
South Seymour	2 ♂	1 ♀	April 23rd.

Syngrapha egena galapagensis form. nov.

James Island	1 ♂		April 5th.
Chatham Island	1 ♂	1 ♀	April 7th.
South Seymour	1 ♂		April 23rd.

Subfamily NOCTUINAE

Melipotis indomita Walk.

Cat. Lep. B. M. Vol. 13. p. 1161 (1857)
Melipotis nigrescens Grote & Robinson.

Conway Bay, Indefatigable	10 ♂	4 ♀	April 1st.
South Seymour	4 ♂	4 ♀	April 23rd.
Tagus Cove, Albemarle	1 ♀		April 6th.

Melipotis harrisoni sp. nov.

Conway Bay, Indefatigable	5 ♀		April 1st.
Tagus Cove, Albemarle	3 ♀		April 6th.
South Seymour	6 ♂	5 ♀	April 23rd.

Anomis professorum sp. nov.

Conway Bay, Indefatigable	2 ♂	2 ♀	April 1st.
James Island	1 ♀		April 5th.
Tagus Cove, Albemarle	2 ♀		April 6th.
Chatham Island	7 ♂	15 ♀	April 7th.
South Seymour	8 ♂	10 ♀	April 23rd.

Gonodonta biarmata Guen.

Noct. II. p. 373 (1852)
Gonodonta elegans Druce.

Conway Bay, Indefatigable	1		April 1st.

Thermesia gemmatalis Hubn.

Zutr. 153, 154.

Conway Bay, Indefatigable	11 ♂	8 ♀	April 1st.
Chatham Island	1 ♂	9 ♀	April 7th.
South Seymour	9 ♂	5 ♀	April 23rd.

Epidromia zephyritis sp. nov.

Conway Bay, Indefatigable	1 ♀		April 1st.

Psorya hadesia sp. nov.

South Seymour	1 ♂	1 ♀	April 23rd.

Rivula ? dubiosa sp. nov.

Conway Bay, Indefatigable	2 ♀		April 1st.

Family GEOMETRIDAE

Subfamily Larentiinae

Eucosmia stellata Guen.

Uranides et Phalenites Vol. II. p. 443 (1857)
Eucosmia impauperata Walk.
Eucosmia albosignata Packard.

Conway Bay, Indefatigable	4	April 1st.
South Seymour	3	April 23rd.

Subfamily Sterrhinae

Perixera ? impudens Warr.

Nov. Zool. XI. p. 487 (1904) Described from Gardner Island.

Conway Bay, Indefatigable	20	April 1st.
James Island	1	April 5th.
Tagus Cove, Albemarle	1	April 6th.

Subfamily Ennominae

Sericosema lignata Warr.

Nov. Zool. XII. p. 362 (1905) Described from S. E. Albemarle.

Chatham Island	1 ♀	April 7th.

Family PYRALIDAE

Subfamily Pyraustinae

Zinckenia fascialis Cramer.

-*Pap. Exot.* IV. pl. 398. f. 0

South Seymour	1	April 23rd.

Pilocrocis ramentalis Lederer.

Wien. Ent. Mon. VII. p. 430. pl. 16. f. 13 (1863)

James Island	1 ♀		April 5th.
South Seymour	4 ♂	2 ♀	April 23rd.

Pilocrocis chathamalis sp. nov.

Conway Bay, Indefatigable	2	April 1st.
Chatham Island	2	April 7th.
South Seymour	1	April 23rd.

Sylepta gordialis Guen.

Delt. et Pyral. p. 374. pl. 5. f. 10 (1854)

Conway Bay, Indefatigable	6 ♂	10 ♀	April 1st.
Tagus Cove, Albemarle	1 ♂	4 ♀	April 6th.
Chatham Island	1 ♂	3 ♀	April 7th.
South Seymour	2 ♂	6 ♀	April 23rd.

Sylepta elevata Fabr.

Ent. Syst. N. 325.

James Island	1		April 5th.

Sylepta silicalis Guen.

Delt. et Pyral. p. 349. (1854)

Conway Bay, Indefatigable	1 ♀		April 1st.
James Island	2 ♂	1 ♀	April 5th.
Tagus Cove, Albemarle	1 ♀		April 6th.
Chatham Island	2 ♀		April 7th.
South Seymour	1 ♂		April 23rd.

Pyrausta eneanalis sp. nov.

Conway Bay, Indefatigable	14		April 1st.
South Seymour	4		April 23rd.
Tower Island	1		April ?.

Subfamily CRAMBINAE

Eromene ocellea Haworth.

Lep. Brit. p. 486 (1811)

Conway Bay, Indefatigable	5 ♂	5 ♀	April 1st.
South Seymour	7 ♂	9 ♀	April 23rd.

Subfamily HYDROCAMPINAE

Piletocera bufalis Guen.

Delt. et Pyral. p. 245 (1854)

Conway Bay, Indefatigable	3		April 1st.

Subfamily PYRALINAE

Beebea guglielmi sp. nov.

Chatham Island	1 ♂		April 7th.

Subfamily PHYCITINAE

Etiella zinckenella Treit.

Schmett. Eur. IX. 1. 201 (1832)

Conway Bay, Indefatigable	3 ♀		April 1st.
South Seymour	1 ♂		April 23rd.

Elasmopalpus ? galdinella sp. nov.

Conway Bay, Indefatigable	1 ♀		April 1st.
James Island	1 ♀		April 5th.
South Seymour	4 ♀		April 23rd.

Fundella agapella sp. nov.

Tagus Cove, Albemarle	1 ♀		April 6th.

Piesmopoda carpasella sp. nov.

Conway Bay, Indefatigable	1 ♂		April 1st.

Nicetiodes apianella sp. nov.

Conway Bay, Indefatigable	2 ♂	5 ♀	April 1st.
South Seymour	5 ♀		April 23rd.
Tower Island	1 ♀		April 23rd.

MICROLEPIDOPTERA

Determined by Mr. A. Busck and Mr. C. Heinrich

Family PTEROPHORIDAE

Pteroporid sp.

Daphne Major	4	April 22nd.
Conway Bay, Indefatigable	8	April 3rd.

Family GELECHIIDAE

Aristotelia howardi Walsingham

Biol. Cent. Amer. IV. p. 23 (1909)

South Seymour	1	April 23rd.

Gelechia bosquella Chambers

Can. Entom. Vol. 7. p. 92 (1875)

Conway Bay, Indefatigable	1	April 1st.

Family OLETHREUTIDAE

Strepsicrates smithiana Walsingham

Proc. Zool. Soc. Lond. p. 506 (1892)

South Seymour	2	April 20th.

Crocidosema plebiana Zeller

Isis. p. 721 (1847)

South Seymour	1	April 20th.

Epinotia sp.

South Seymour	1	April 22nd.

Epinotia sp.

South Seymour	1	April 23rd.

Epinotia sp.

James Island	1	April 5th.

Family HYPONOMEUTIDAE

Atteva hysginiella Wallengren

Resa Eugen. 2. p. 386 (1861)
Atteva sylpharis Butler

Conway Bay, Indefatigable	1	April 1st.
James Island	1	April 5th.
Chatham Island	4	April 6th.
Daphne Major	2	April 22nd.
South Seymour	10	April 23rd.

Family NOCTUIDAE

Subfamily AGROTINAE

Euxoa williamsi, sp. nov.

Female.—Palpi, head, and thorax wood brown with some faint grayish mottling, the palpi with some black scaling laterally; collar and patagia mottled and suffused with black. Abdomen whitish, dorsally thickly irrorated with grayish olive and covered with drab gray hairs, the anal hairs clay color, ventrally some grayish olive irrorations; thorax below mouse gray. Fore tarsi, mid and hind tibiae, and tarsi mostly black, the tarsi with white rings. Fore wing mostly fuscous, the markings snuff brown; basal and antemedial lines indistinct, curved, and sinuous, the antemedial outwardly finely edged with black; orbicular as a very small black annulus filled in with whitish scales; reniform small, its outer edge incurved, buff brown, proximally edged by a black line preceded by some black scaling, and is inwardly crossed by a fine black line; postmedial line obsolescent on costa, curved beyond cell, inbent to inner margin, consisting of small lunular spots on interspaces; subterminal line fine, dentate, partly irrorated with white; buff white points on outer half of costa; cilia iridescent drab gray, shaded at base with dark neutral gray and crossed by a similar line. Hind wing silky light drab, slightly whitish at base and with a fine darker terminal line; cilia white, crossed by a dark line at base. Wings below silvery pale smoke gray irrorated on costal margins and termen of fore wing with mouse gray; a faint dark postmedial line, slightly outcurved on both wings; a few dark scales on discocellulars. The male has the antennae pectinated, the terminal fifth minutely serrate. Fore wing more of a wood brown, the veins finely black, the postmedial line black, fine and lunular, otherwise as in the female.

Expanse male and female 40 mm.

Habitat: Indefatigable, James Island, Albemarle and South Seymour.

Type Cat. No. 26504. U. S. N. M.

Named in honor of Mr. Harrison Williams.

Lycophotia oceanica, sp. nov.

Male.—Palpi, head, and thorax light drab, vertex whitish, a black transverse line on collar; abdomen above drab gray, with a few black irrorations, and darker transverse lines, some cinnamon buff hairs in anal tuft, underneath darker; legs deep mouse gray, white rings at base of tarsi; outer spurs on hind tibiae white with a black ring. Fore wing silky, light mouse gray, with a few black irrorations, and transverse striae on medial space; small black spots on costa at origin of lines, a subbasal point in cell, and a larger antemedial point on median, and inner margin; faint antemedial and medial fuscous lines, and a broader shade on inner side of subterminal which is sinuous, whitish gray, defined by darker terminal shading except at apex which is whitish gray; orbicular small, ovate longitudinally, outlined in fuscous; reniform outlined in white partly edged with fuscous; an outcurved postmedial series of black points on veins; a fine terminal black line inwardly edged with some whitish gray scales;

basal scales of cilia rather darker. Hind wing whitish suffused on outer half with light drab, the veins drab. Fore wing below and costa of hind wing silky mouse gray, the hind wing otherwise whitish.

Expanse 32 mm.

Habitat: Galapagos Islands, the type from South Seymour.

Type Cat. No. 26505. U. S. N. M.

Can be placed near *Lycophotia lubricans* Guenée.

Subfamily HADENINAE.

Cirphis cooperi, sp. nov.

Female.—Palpi hazel laterally mottled with black; frons and vertex hazel, the latter shaded behind with chestnut brown; thorax benzo brown; abdomen above drab, the lateral and anal hairs light vinaceous cinnamon, underneath shaded with buff-pink; legs partly fringed with buff-pink hairs, the fore and mid tarsi fuscous with faint buff-white rings, the hind tarsi drab. Fore wing silky cinnamon brown, the markings black; an outcurved, lunular, antemedial line with points on veins; a faint lunular postmedial line with distinct points on veins, outcurved beyond cell, incurved above inner margin; a white mark on discocellular from vein 5 to beyond vein 3, edged on either side with black; a faint subterminal black shade, only distinct from vein 7 to vein 4; tips of veins irrorated with drab gray and black; terminal line faint, slightly darker than wing; cilia iridescent, changing from drab gray to cinnamon brown, crossed near base by a dark line. Hind wing silky drab, the cilia suffused with buff-pink; faint terminal dark points on interspaces. Wings below mostly shining congo pink, the costal margins irrorated with black; short postmedial black streaks on veins; terminal black markings on interspaces.

Expanse 44 mm.

Habitat: Conway Bay, Indefatigable.

Type Cat. No. 26506. U. S. N. M.

In appearance somewhat like *C. pyrrhias* Meyr. from the Hawaiian Islands. Named in honor of Miss Isabel Cooper, the scientific artist of the expedition.

Trachaea roseae, sp. nov.

Male.—Palpi mottled clay color, gray, and whitish, with lateral black patches on first and second joints, the third with some black at base and behind. Head, collar, and thorax chiefly fuscous, mottled with a little whitish gray; abdomen above drab, underneath mottled white and clay color; tarsi black with white rings. Fore wing buffy brown irrorated with black, the veins mostly slate color partly irrorated with gray scales; a semi ovate fuscous spot on base of costa and a similar spot below cell, both edged with black; sinuous black antemedial and medial lines, the latter more distinct, the space between them suffused with slate color; orbicular oblique formed by a horse shoe line; reniform narrow, incurved, preceded by a fuscous black line; a small cluster of white scales adjoining cell between veins 3 and 4; postmedial line double, fuscous black, forming two streaks on costa, then outset, outcurved and inbent from vein 11 to vein 4, outcurved to vein 3, then forming three incurved lunules

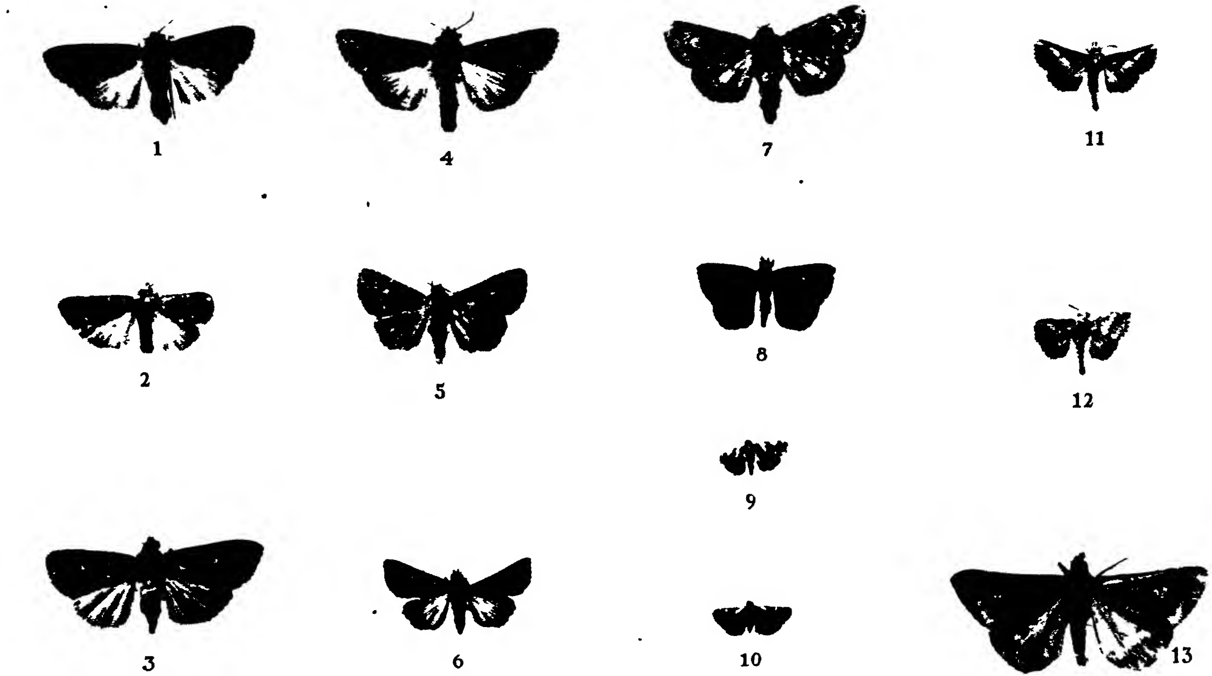

Plate I. ILLUSTRATIONS OF TWO NEW GENERA AND TWENTY-SIX NEW SPECIES OF MOTHS

Collected by William Beebe in the Galapagos Islands.

1, *Euxoa williamsi* Schaus; 2, *Lycophotia oceanica* Schaus; 3, *Cirphis cooperi* Schaus; 4, *Trachaea roseae* Schaus; 5, *Perigea ruthae* Schaus; 6, *Perigea ebba* Schaus; 7, *Harrisonia williamsi* Schaus; 8, *Amyna insularum* Schaus; 9, *Spragueia creton* Schaus; 10, *Spragueia plumbeata* Schaus; 11, *Paectes indefatigabilis* Schaus; 12, *Paectes isabel* Schaus; 13, *Mocis incurvalis* Schaus.

to inner margin; subterminal line white, straight from costa to vein 7, then lunular and irregular, preceded by fuscous black forming a broad shade between veins 5 and 2; a faint marginal lunular white line, filled in with fuscous black on each interspace; cilia buff and slate color, cut by white spots at veins. Hind wing whitish largely suffused with drab; cilia white. Wings below whitish suffused with drab; a faint darker postmedial line, the hind wing with a faint line on discocellular and slate color irrorations on costa.

Expanse 43 mm.

Habitat: Conway Bay, Indefatigable.

Type Cat. No. 26507. U. S. N. M.

Named in honor of Miss Ruth Rose of the expedition.

Perigea ruthae, sp. nov.

Male.—Palpi whitish gray irrorated with black, shaded in front with vinaceous pink. Head, collar, and thorax gray thickly irrorated with black, forming a transverse line on collar, shaded on vertex, collar, and patagia with vinaceous pink. Abdomen above gray, the anal hairs and underside whitish buff, venter with black hairs; a series of sublateral black points. Legs whitish irrorated with gray and black, the fore femora and tibiae almost black, the latter with some vinaceous pink scaling; tarsi black with white rings. Fore wing silky mouse gray, irrorated with coarse black scales at base, forming an irregular outbent subbasal line; costa black cut by whitish buff points; the lines black, the antemedial lunular, proximally edged with whitish buff, the lunule in cell and below it followed by black spots; a fainter medial line, in cell heavily edged above and below with black preceded by the orbicular formed by a whitish buff annulus, followed by the reniform which is white behind, pinkish buff in front and edged with black; postmedial line macular to vein 4, outwardly edged with pinkish buff scales, the spot between veins 4 and 5 with a projecting black line to reniform, below vein 4 the line is double, lunular, filled in with pinkish buff, followed throughout on veins by white points with black points on either side; subterminal well marked, irregular, followed by some pinkish buff scaling; a faint terminal line with white points on veins, cilia hair brown with darker mottling. Hind wing blackish gray; a white streak from base to termen near anal angle; a postmedial black curved line from vein 6 to vein 2. Wings below white irrorated with neutral gray, the fore wing with disc deep neutral gray and a darker postmedial line with black streaks on veins and interspaces from costa to vein 2; the hind wing with a black point on discocellular and a postmedial line from costa to vein 2, the cilia pinkish buff at base followed by a black line and tipped with white.

Expanse 34 mm.

Habitat: Tagus Cove, Albemarle; also occurs on other islands.

Type Cat. No. 26508. U. S. N. M.

A very distinct species.

Named in honor of Miss Ruth Rose.

Perigea ebba, sp. nov.

Male.—Palpi vinaceous pink irrorated with black especially at sides, the third joint with a black ring and white tip. Head, collar, and thorax vinaceous brown with some black and white scales. Abdomen above dark gray with whitish segmental lines preceded by brown lines, underneath cream white with some scattered black scales and black points at sides. Legs chiefly white irrorated with black, the fore tarsi black with white rings. Fore wing mars brown slightly suffused with purple, the veins black irrorated with white; interspaces between veins 2 and 5 adjoining cell grayish black irrorated with white; lines fine, black, the subbasal outcurved on costa, outbent below it, the antemedial lunular, the postmedial sinuous outwardly paler edged and followed by white points on veins; subterminal shade blackish, narrow and irregular, outwardly paler edged; orbicular and reniform defined by a few whitish inconspicuous scales; a crenulate terminal black line with white points on veins. Hind wing whitish thinly suffused with fuscous, more heavily on terminal third; cilia yellowish white. Fore wing below dusky, the costa shaded with vinaceous pink irrorated with black; a vertical postmedial line; cilia fawn color. Hind wing below white thickly irrorated with dark gray except on inner area; cilia as above.

Expanse male 28 mm., female 30 mm.

Habitat: James Island, Indefatigable and South Seymour.

Type Cat. No. 26509. U. S. N. M.

Comes nearest *P. vacillans* Walker.

Harrisonia, gen. nov.

Proboscis fully developed; palpi upturned, thickly scaled, smooth, the first joint well fringed below, the second with longer hairs above, the third joint slightly porrect, short, the tip rounded; frons rounded, smooth; eyes large, round; antennae of male minutely serrate with short fascicles of hair, the terminal half simple, the antennae of female simple; thorax clothed almost entirely with hairs; abdomen with slight tuft at base, and longer lateral tufts; femora fringed with long hair; tibiae thickly scaled, and partly fringed. Fore wing with the apex rounded, the termen evenly curved; veins 3 and 5 from near angle of cell; 6 from upper angle; 9 from 10 anastomosing with 8 to form the areole; 8 and 9 on short stalk; 11 from cell. Hind wing with veins 3, 4 from angle of cell; 5 obsolescent from middle of discocellulars; 6 and 7 from upper angle; 8 anastomosing with the cell near base only.

Type of genus *Harrisonia williamsi*, sp. nov.

Harrisonia williamsi, sp. nov.

Male.—Palpi light drab, the first joint brown mottled with black hairs; head and thorax light drab, a blackish shade on collar; abdomen tilleul buff shaded dorsally with drab gray forming transverse bands; legs mostly drab gray, the tarsi above deep mouse gray with whitish rings. Fore wing pale drab gray mostly shaded with drab gray and irrorated with light drab except on termen, the markings black; a subbasal line from costa to below median, in-

angled on subcostal; antemedial fine inangled in cell and on submedian, expanding and forming spots on costa, median, and inner margin; a fine medial dark shade outbent on costa to reniform, slightly incurved below it; postmedial well defined, lunular dentate, outcurved beyond cell; orbicular as a black point; reniform almost round, its outer edge slightly incurved; a broad subterminal smoky shade, narrower from vein 5 to vein 2; termen pallid neutral gray, whitish at apex; terminal blackish spots expanding on base of cilia, the tips of cilia white. Hind wing buff white suffused with mouse gray; a round spot on discocellular and postmedial line outcurved between veins 5 and 2; termen broadly deep mouse gray; cilia fuscous tipped with white. Wings below white suffused with ivory yellow; dark spots on discocellular and a thick postmedial line; dark marginal shading on interspaces; cilia of fore wing with dusky shading at base and tips; cilia of hind wing ivory yellow at base, white at tips separated by a faint smoky line. The female has the hind wing above almost entirely deep mouse gray without markings, the underside of the wings largely suffused with deep mouse gray.

Expanse male and female 39 mm.

Habitat: South Seymour.

Type Cat. No. 26510. U. S. N. M.

Subfamily ERASTRIINAE

Amyna insularum, sp. nov.

Male.—Head and thorax dark mouse gray, the palpi with whitish irrorations, the scales on head, collar, and patagia finely tipped with whitish gray; abdomen mouse gray above, the dorsal tuft like thoracic scales, the underside and thorax below whitish, the venter with some dark mouse gray scaling; legs mottled dark mouse gray and white, the tarsi above black with white rings. Fore wing deep mouse gray, the scales finely tipped with whitish gray, the lines velvety black; subbasal line macular; antemedial line sinuous inangled above submedian, the fovea preceding it edged above with black; a medial shade from subcostal suffusing below cell on interspaces with postmedial; reniform very indistinct, sometimes with lower part filled in with white; postmedial line outcurved beyond cell, dentate with a few white scales at points; subterminal line black, proximally diffuse, distally sinuous; an interrupted terminal black line; four oblique white lines on costa before apex; a few white scales on cilia. Hind wing chaetura drab, faintly whitish at base of costa; a dark postmedial line defined by paler outer edge; cilia tipped with white on apical half. Fore wing below deep mouse gray, the costa paler with dark irrorations; a minutely lunular postmedial line. Hind wing below whitish thickly irrorated with mouse gray; a dark point on discocellular; postmedial line as on fore wing; an interrupted terminal black line; cilia shining white or gray.

Expanse male 28 mm., female 30 mm.

Habitat: Conway Bay, Indefatigable; also on other islands.

Type Cat. No. 26511. U. S. N. M.

Belongs to the same group as *A. octo* Guenée.

A very distinct species.

Spragueia creton, sp. nov.

Male.—Head, collar, and thorax metallic slate color; palpi yellowish white with dark rings on second and third joints; abdomen above fuscous black with white segmental lines, underneath yellowish white. Fore wing slate color; a broad white fascia from near base of costa to near middle of inner margin, outwardly shaded with orange cinnamon from below cell; a triangular white spot medially on costa containing a black point on costal edge; a smaller subterminal spot on costa; an erect postmedial white bar on inner margin to vein 5 continuing as a fine indistinct line to the smaller white costal spot; termen rather broadly white suffused with ochraceous orange; an interrupted terminal black line; cilia mostly black, at apex white. Hind wing hair brown, the cilia tipped with white. Fore wing below hair brown; a whitish spot on costa before apex.

The female has the markings reduced with only a few orange cinnamon scales at the erect postmedial bar of inner margin which is reduced to a fine line.

Expanse male and female 15 mm.

Habitat: Tower Island and South Seymour.

Type Cat. No. 26512. U. S. N. M.

Allied to *S. dama* Guenée.

Spragueia plumbeata, sp. nov.

Female.—Head, collar, and thorax metallic blackish plumbeous; palpi white, the second and third joints broadly tipped with black; abdomen above black with whitish segmental lines, laterally oblique, underneath white; legs white below, black above, the tarsi and hind tibiae with white rings. Fore wing shining blackish plumbeous, the lines black; a thick line from base of costa oblique, extending along median vein to postmedial line; a streak from base along submedian to a medial line from cell to inner margin; a postmedial line expanding between veins 5 and 2; a broad terminal line and the costal margin between the spots and towards apex; an oblique white spot from near base of costa to within cell; an irregular, almost round spot on costa medially to below subcostal, and a short oblique white line before it; a small triangular postmedial spot; all the spots edged with black suffusing with the lines; from apex of postmedial spot a short line is inbent to postmedial at vein 5, enclosing a small spot of ground color; cilia shining blackish plumbeous. Hind wing benzo brown, the cilia as on fore wing but shaded with black at base.

Expanse 16 mm.

Habitat: Conway Bay, Indefatigable.

Type Cat. No. 26513. U. S. N. M.

Subfamily EUTELIINAE

Paectes indefatigabilis, sp. nov.

Male.—Head, collar, and thorax whitish; palpi laterally avellaneous, the frons mottled with avellaneous, the collar broadly cinnamon brown in front, some fuscous black scales posteriorly, and the thorax with a few black and

cinnamon brown scales; abdomen above whitish gray suffused with brown, underneath white with a black and two brown lines. Fore wing: from base expanding to inner margin light gull gray; costal margin to subterminal line broadly deep mouse gray; a fine lunular subbasal black line; antemedial fine, double, black, outcurved at median, inangled on submedian, the outer line dark brown from cell and preceded below median by some white scaling, followed throughout by a broad deep mouse gray shade; medial space to postmedial and obliquely to dark costa white, crossed by a very fine double, lunular medial line, the outer line passing around reniform; orbicular a small ovate black line; reniform indistinct with cinnamon brown points at the ends of discocellular; postmedial line double, distinct, black on costa and deeply outbent, curved at vein 7, cinnamon brown, sinuous and inbent to inner margin, followed by deep mouse gray irrorations crossed by a black line from below vein 5, and followed by the irregular, and macular subterminal mummy brown line; termen whitish thickly irrorated with mouse gray except at apex; a terminal lunular black line preceded by some small brownish patches; between veins 6 and 7 a black line from postmedial to termen; cilia mottled white and brown gray forming darker spots from veins. Hind wing whitish suffused with benzo brown, becoming fuscous black on termen; vein 2 and inner margin black and white; cilia white with brownish spots at base. Fore wing below hair brown, the costa white irrorated with brown and with four white streaks towards apex; a dark crenulate terminal line; cilia white crossed by a dark line and with dark spots terminally. Hind wing below whitish suffused with drab and on termen with purplish red; an irregular medial line crossing discocellular; a double series of black postmedial streaks on veins followed by a more continuous subterminal line.

Female more uniformly gray, the costa of fore wing hardly darker, the antemedial line single, black, and more conspicuous owing to the dark shades beyond it of the male being absent; shades following postmedial much paler.

Expanse male and female 24 mm.

Habitat: Conway Bay, Indefatigable; also occurs on South Seymour.

Type Cat. No. 26514. U. S. N. M.

Comes nearest *Paectes obrotunda* Guenée.

Paectes isabel, sp. nov.

Male.—Head, collar, and thorax pale drab gray; abdomen above whitish gray with black dorsal spots on third and two last segments, underneath white; legs buff white, the tarsi blackish with pale rings, the fore tibiae pale drab gray. Fore wing pale drab gray, the markings black; antemedial line consisting of a short streak on subcostal, an angled line across median vein with some brown scales below median, expanding into a broad line angled both ways on submedian, then narrow on inner margin; a faint drab point at each end of discocellular; postmedial very faint on costa and outbent, angled below vein 7, thick, incurved to inner margin, marked by some vinaceous russet scaling between veins 2 and 5; a thick black line above vein 6 from postmedial to termen, and a short streak below vein 6; terminal space suffused with ecru drab; cilia mottled white and light drab with black lines at veins 5 to 7. Hind wing white suffused with buff, the termen broadly fuscous black; postmedial black streaks

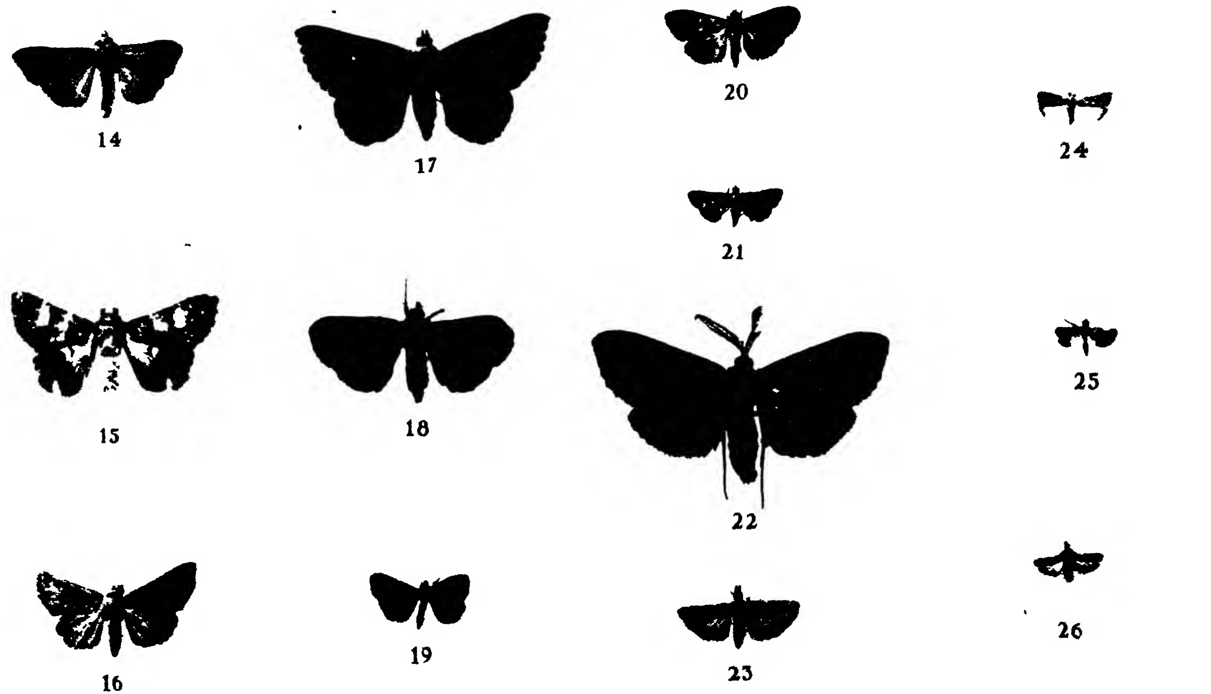

Plate II ILLUSTRATIONS OF TWO NEW GENERA AND TWENTY-SIX NEW SPECIES OF MOTHS
Collected by William Beebe in the Galapagos Islands.

14, *Syngrapha egena galapagensis* Schaus 15, *Melipotis harrisoni* Schaus; 16, *Anomis professorum* Schaus; 17, *Epidromia zephyritis* Schaus 18, *Psorya hadesia* Schaus; 19, *Rivula dubiosa* Schaus, 20, *Pilocrocis chathamalis* Schaus, 21, *Pyrausta eneanalis* Schaus, 22, *Beebea guglielmi* Schaus 23, *Elasmopalpus galdinella* Schaus, 24, *Fundella agapella* Schaus, 25, *Piesmopoda carpasella* Schaus; 26, *Nicetiodes apianella* Schaus.

on veins; a black streak with white spots along inner margin; cilia white with hair brown spots at veins. Wings below mostly hair brown; cilia white with hair brown shaped spots at veins; hind wing with two rows of dark streaks at veins.

Expanse 23 mm.

Habitat: Conway Bay, Indefatigable.

Type Cat. No. 26515. U. S. N. M.

I take pleasure in naming this charming species in honor of Miss Isabel Cooper.

Subfamily PHYTOMETRINAE

Syngrapha egena galapagensis, fm. nov.

Male.—Fore wing drab, the medial space below cell to inner margin darker, also the subterminal space, the latter with only a very faint cupreous shade; the direction of lines and markings as in *S. egena* Guenée; it is also smaller than that species.

Expanse 34 mm.

Habitat: James Island.

Type Cat. No. 26516. U. S. N. M.

Subfamily CATOCALINAE

Mocis incurvalis, sp. nov.

Male.—Head, collar, and thorax drab, the scales and hairs tipped with whitish gray; abdomen vinaceous buff suffused above with pale drab; thorax below and legs avellaneous. Fore wing light drab; subbasal line faint, drab, forming a small spot on costa and on median; antemedial broader, slightly inbent, distally broadly shaded with black from cell to inner margin, cut by the pale submedian vein; orbicular a white point edged with a few black scales; a very faint, fine, double, medial drab line, lunular dentate; reniform large consisting of three black lines obscured by black between them; postmedial fine, black, outcurved and punctiform below costa, inangled and curved to below vein 2 near cell, then slightly outcurved followed by a broad black shade, more intense within angle of line below vein 2, and diverging to subterminal at submedian; subterminal line indicated by black points on veins; some dark terminal shading between veins 2 and 5; a faint interrupted terminal line. Hind wing suffused with light drab, darker shaded on termen; postmedial and subterminal darker lines. Hind wing below clothed with long silky light brown hairs. The hind tibiae and tarsi heavily fringed. Female mouse gray irrorated with brown and fuscous white tipped scales, the antemedial line vertical, fine, with a small velvety black spot on inner margin; reniform large without black shading or lines; postmedial line shaped as in male broadly followed by a deep mouse gray shade in place of black.

Expanse male 48 mm., female 45 mm.

Habitat: the male from Conway Bay, Indefatigable, the female from South Seymour.

Type Cat. No. 26517. U. S. N. M.

The postmedial line differentiates this species from any of those known.

Subfamily Noctuinae

Anomis professorum, sp. nov.

Male.—Head, collar, thorax and fore wing varying from buffy brown to sayal brown irrorated with darker scales. Abdomen above drab with pale segmental lines; a lateral vague line, the anal hairs and base of abdomen below whitish, the latter otherwise suffused with russet vinaceous; mid tibiae, hind tibiae and tarsi whitish irrorated with russet vinaceous; fore tibiae and tarsi russet vinaceous irrorated with white. Fore wing with the lines fine, fuscous black; antemedial line inwardly pale edged, outbent from costa forming a lunule below cell and one below submedian; orbicular a white dark edged point; reniform large, somewhat oblique 8 shaped fuscous black or white, in the latter case crossed by a fine black line; postmedial outwardly pale, edged, outcurved between veins 7 and 6 and 5 and 4, deeply incurved between 5 and 6, incurved between 4 and 3 then in and upbent to within cell before reniform, obliquely downbent to fold below cell and obliquely outcurved to inner margin; subterminal shade fuscous black, sinuous; a terminal lunular line preceded by slightly fuscous shadings; cilia of ground color with faint pale line at base and white tips spotted with black. Hind wing hair brown, cilia similar but light buff at base and tipped with white. Fore wing below hair brown; inner margin narrowly and a streak of hairs in cell white; subcostal and veins above 4 irrorated with white; termen light buff shaded with onion skin pink towards apex. Hind wing below white the costal half thickly irrorated with russet vinaceous; a similar minutely lunular postmedial line; a white streak on discocellular; some dark subterminal shading; cilia white crossed by faint mouse gray shading.

Expanse 30 mm.

Habitat: Chatham and other islands.

Type Cat. No. 26518. U. S. N. M.

Comes nearest *A. doctorum* Dyar, distinguished by the uniformly darker hind wing.

Melipotis harrisoni, sp. nov.

Male.—Palpi white mottled with gray, the base of second joint laterally hair brown, some black irrorations in front; head white with some drab gray hairs on upper part of frons; collar chaetura drab with some white scales medially; thorax dorsally white, the metathoracic tuft tipped with drab gray and black, the patagia black, somewhat metallic, mottled with a few white and deep mouse gray scales. Abdomen white with dorsal transverse pale drab gray bands and a few scattered black scales; thorax below white, the fore femora mottled with black hairs, the tibiae white irrorated with black, the tarsi black with white rings. Fore wing hair brown, the lines fine, velvety black; basal area to antemedial suffused with blackish slate, and with black shades before the lines; subbasal line outbent to below cell, obsolescent to submedian, curved below it; antemedial sinuous, outbent to near middle of inner margin, followed by a broad whitish fascia irrorated with cinnamon drab and crossed by a similar vertical medial line from below cell, its outer edge dentate on costa and upper part of cell followed by black to postmedial line, but interrupted by the large white reniform; the postmedial line forms the outer edge of reniform, is outangled

at vein 6, incurved to vein 4, then curved round to cell below vein 3 and slightly outbent to inner margin; costal space beyond suffused with black with four short white streaks, the last forming the origin of a whitish subterminal line, incurved on costal margin, then sinuous and very faint to inner margin; a faint black terminal line preceded by black points on interspaces. Hind wing below with basal half white, reaching anal angle on inner margin; a thick curved black line on discocellular emitting a short streak in cell; outer half black with terminal white spot below vein 2; the termen from apex to just below vein 5 whitish with deep grayish olive irrorations; cilia as above.

The female differs in having the medial space of fore wing hair brown, the terminal space deep mouse gray or sometimes light mouse gray; the base of hind wing more densely suffused with fuscous black; fore wing below with dark hairs in cell and along median vein.

Expanse male and female 40 mm.

Habitat: South Seymour and other islands.

Type Cat. No. 26519. U. S. N. M.

Named in honor of Mr. Harrison Williams.

The species comes nearest *M. famelica* Guenée, but the hind wing is conspicuously different.

Epidromia zephyritis, sp. nov.

Female.—Head and thorax dark mouse gray, the scales tipped with whitish gray; abdomen light drab clothed dorsally with dark mouse gray as on thorax, underneath light drab with mouse gray irrorations; legs dark mouse gray mottled with white. Wings deep mouse gray irrorated with black and white, the lines black. Fore wing: a wavy subbasal line; antemedial outbent on costa, bluntly inangled in cell, lunular below cell; orbicular a creamy white point; medial line outcurved across cell, incurved below vein 2; reniform faintly defined by a black line, with a creamy white point in front, and a similar curved mark behind; postmedial fine, outcurved and wavy; subterminal large black spots close to postmedial between veins 6 and 5, and below vein 2, these two spots being outwardly shaded with cinnamon; a fine terminal, lunular line with white points on veins; cilia white crossed by a dark line. Hind wing: a postmedial line to inner margin near inner angle, followed by a deeply dentate cinnamon shade; terminal line as on fore wing with smaller white points; cilia fuscous with some white hairs. Wings below drab, the costa of fore wing and entire hind wing irrorated with whitish gray; a postmedial dark line, outwardly pale shaded; a faint blackish subterminal shade; cilia mostly white; a pale line on discocellular of fore wing.

Expanse 48 mm.

Habitat: Conway Bay, Indefatigable.

Type Cat. No. 26520. U. S. N. M.

A very distinct species.

Psorya, gen. nov.

Palpi obliquely upbent, the second joint slender, densely clothed with short hairs, slightly fringed above, reaching above frons, the third joint smooth, as long as second, the tip rounded; frons with a triangular corneous ridge in front;

antennae long, shortly pectinated with a long cilia at end of pectinations; abdomen without dorsal tufts; legs smooth, the femora with fringe of hairs; the inner terminal spur of mid and hind tibiae long. Wings moderately broad, the outer margins rounded. Fore wing: veins 3 and 5 from near angle of cell; 6 from upper angle; 9 from 10 anastomosing with 8 to form the areole. Hind wing: cell short hardly one third of length of wing; veins 3 and 4 shortly stalked; 5 close to angle; 6 and 7 from upper angle; 8 anastomosing with cell near base only.

Type of genus *Psorya hadesia*, sp. nov.

Psorya hadesia, sp. nov.

Female.—Head and thorax mouse gray, mottled with chaetura drab forming numerous fine wavy, transverse lines; abdomen hair brown above, light buff gray underneath and with small lateral fuscous black tufts; legs chiefly black, the tarsi with white rings. Wings mouse gray thickly irrorated with black, terminal black spots on interspaces; cilia black with mouse gray spots at veins. Fore wings: a subbasal black point in cell; an antemedial black line, almost vertical, slightly inangled below cell; orbicular a black point; a vertical medial line slightly wavy below cell; reniform large outlined by a broken black line, filled in with clearer gray and partly crossed on proximal side by a black line; postmedial line black outcurved and minutely dentate beyond cell, incurved below vein 4 then parallel with medial line; subterminal line black, faint, lunular, marked with some black points. Hind wing: an antemedial and a medial minutely dentate black line, the latter with some whitish scales on its outer edge; a very faint postmedial line; the terminal space darker than the postmedial space. Wings below buffy mouse gray thickly irrorated with darker scales; a few black scales on discocellulars; a faint black postmedial line; fore wing with a subterminal punctiform line, the hind wing with a subterminal black shade.

Expanse 39 mm.

Habitat: South Seymour.

Type Cat. No. 26521. U. S. N. M.

Rivula ?dubiosa, sp. nov.

Female.—Palpi fuscous with a few white scales in fringe; head, thorax, and abdomen hair brown, the scales on patagia with white tips, the base of abdomen underneath white; legs chiefly hair brown, the tarsi with whitish rings.

Fore wing whitish thickly irrorated with fuscous, the terminal space olive brown; costal margin largely fuscous, forming a triangular patch medially with the apex reaching lower angle of cell; the lines white on costa; a basal, subbasal and antemedial line, the latter outcurved, distally edged with fuscous; orbicular a fuscous annulus, from cell below it, an oblique fuscous shade extending along submedian fold to postmedial; reniform forming two small crescents outlined in fuscous; beyond cell between veins 5 and 6 a small ovate linear spot; postmedial line well outcurved from vein 7 to vein 3, then slightly incurved, its outer edge with white scaling, the subterminal punctiform, white, parallel with it; terminal white points on veins; cilia fuscous crossed by two fine wavy

black lines. Hind wing hair brown; a fine black terminal line; cilia partly tipped with whitish. Fore wing below light drab, the termen broadly pale drab gray preceded by a narrow blackish shade. Hind wing below pale drab gray with darker irrorations on costa; a dark line on discocellular; faint postmedial streaks on veins and a wavy blackish subterminal shade; a terminal fuscous black line on both wings cut by whitish streaks on veins.

Expanse 19 mm.

Habitat: Conway Bay, Indefatigable.

Type Cat. No. 26522. U. S. N. M.

Without a male the exact position of this species is uncertain.

Family PYRALIDAE

Subfamily PYRAUSTINAE

Pilocrocis chathamalis, gen. nov.

Female.—Palpi brown, the first joint and lower part of fringe on second white, the throat white; frons, collar, and thorax light drab, the vertex tawny olive; abdomen above drab with whitish segmental lines, underneath whitish; legs whitish, streaked above with drab. Fore wings shining buffy brown, terminally suffused somewhat with fuscous, the lines black; a subbasal line; the antemedial line outbent from costa, downcurved below cell; orbicular a small black spot; reniform small almost quadrate, black with a few brownish scales on it; a buffy shade between spots; postmedial line incurved on costa, outcurved beyond cell, dentate between veins 5 and 2, upcurved to near cell, then downbent, vertical to inner margin, outangled above submedian; cilia whitish shaded with dark neutral gray. Hind wing whitish at base, the inner margin buffy brown, otherwise as on fore wing; a dark streak on discocellular; the postmedial black line outcurved and dentate between veins 5 and 2, then upbent to near cell and inbent to near middle of inner margin. Wings below light buff slightly suffused with drab gray, the lines as on upper surface.

Expanse 27 mm.

Habitat: Chatham Island; also Indefatigable and South Seymour.

Type Cat. No. 26523. U. S. N. M.

Comes nearest *P. cyclostigma* Dyar from Panama.

Pyrausta eneanalis, sp. nov.

Female.—Head and body above deep mouse gray, underneath white, the venter suffused with light buff; legs light mouse gray. Fore wing deep mouse gray thickly irrorated with whitish scales, the lines rather thick defined by the absence of white scales; antemedial line outcurved; a point in cell and dark spot on discocellular; postmedial line slightly outbent from costa somewhat incurved below vein 3 to inner margin; faint terminal dark spots; cilia deep neutral gray to light neutral gray according to light. Hind wing light drab, darker shaded on termen; faint blackish terminal spots. Wings below silky drab gray with a faint dark postmedial line; cilia below more of a whitish gray.

Expanse 18 mm.

Habitat: Conway Bay, Indefatigable, also South Seymour and Tower Island.

Type Cat. No. 26524. U. S. N. M.

In a few specimens the white irrorations on fore wing are so reduced that the lines and spots almost disappear.

Subfamily Pyralinae

Beebea, gen. nov.

Palpi twice the length of head, the third joint downcurved, thickly clothed with short hair, the first joint with long fringe below; maxillary palpi filiform; antennae bipectinate to tips, legs smooth. Fore wing broad; costa straight, rounded at apex; termen rounded towards tornus; veins 3 and 4 from angle; 5 close to angle; 6 from upper angle; 7, 8, 9 stalked, 7 from before 9; 10 and 11 free. Hind wing: veins 3, 4, 5 from lower angle; 6 and 7 shortly stalked.

Type of genus *Beebea guglielmi*, sp. nov.

Beebea guglielmi, sp. nov.

Male.—Head benzo brown; thorax slightly paler; abdomen above cinnamon drab on basal segment, otherwise fuscous with light buff segmental lines; legs hair brown with light buff rings at end of tibiae. Fore wing brownish drab, the markings black; costal margin fuscous; a thick basal line not reaching inner margin; a broad antemedial fuscous shade; a thick medial line slightly incurved between fold and submedian, connected on submedian with postmedial by a black bar; a small spot in cell beyond medial followed by a larger spot on discocellular; postmedial outbent from vein 8 to vein 5, somewhat lunular to vein 3, upbent to lower angle of cell below vein 3 and wavily downbent to inner margin; termen broadly shaded with fuscous to near postmedial; small terminal black spots on interspaces. Hind wing similar; a small black spot on discocellular; a broad diffuse postmedial line, upbent below vein 3 to cell and downbent to inner margin near anal angle; termen as on fore wing. Wings below more of a drab color, the postmedial line much finer, on hind wing dentate; small black lines on discocellulars.

Expanse 58 mm.

Habitat: Chatham Island.

Type Cat. No: 26525. U. S. N. M.

A very remarkable looking species.

I take pleasure in naming this new genus and species in honor of Mr. William Beebe.

Subfamily Phycitinae

Elasmopalpus ? galdinella, sp. nov.

Female.—Head black, the frons white; palpi white below, the second and third joints terminally broadly black; thorax black, the collar and patagia white irrorated with black; abdomen above fuscous with white segmental lines, underneath white with some gray irrorations; throat white; legs white with broad black rings on tibiae, narrower rings on tarsi, the white portions irrorated with black. Fore wing white largely obscured by black scaling leaving a subbasal and antemedial oblique fascia white, the antemedial with diffuse edges and followed shortly above submedian by white scaling; a subterminal vertical white fascia

slightly inbent on costa, inangled opposite cell; a black spot on discocellular defined by white irrorations above it to costa, and less so around it; cilia mottled white and light mouse gray. Hind wing whitish suffused with silky light drab, the termen narrowly fuscous; cilia white crossed by a dark grayish line at base. Wings below silky light drab.

Expanse 23 mm.

Habitat: Conway Bay, Indefatigable, South Seymour, James Island.

Type Cat. No. 26526. U. S. N. M.

Without a male the position of this species is uncertain.

Piesmopoda carpasella, sp. nov.

Male.—Palpi whitish, the first and second joints with lateral terminal fuscous spots, the third joint black, tipped with white; head white irrorated with black; collar pale drab gray shaded in front with tawny; thorax pale drab gray, the scales on metathorax and tips of patagia darker; abdomen above mottled black and white at base, otherwise drab gray, underneath white, the anal hairs buff white; legs mostly white with black rings. Fore wing above white finely irrorated with brown and black; some pale tawny shading before medial line, postmedially below vein 2, and on discocellular, the latter with black points at each end; base black obliquely expanding to inner margin; medial line black, outcurved on costa, almost vertical across cell, very faint and incurved below cell, defined by a few black scales; subterminal line partly black, double, slightly sinuous, parallel with termen, its outer line brown except on costa; terminal triangular black spots on interspaces; cilia silvery brown gray. Hind wing whitish suffused with drab, more pronounced towards apex, the termen fuscous; cilia olive brown tipped with grayish white. Wings below silky drab gray, the termen narrowly, and apex of fore wing black.

Expanse 12 mm.

Habitat: Conway Bay, Indefatigable.

Type Cat. No. 26527. U. S. N. M.

Fundella agapella, sp. nov.

Female.—Head, palpi, thorax and fore wing pallid neutral gray almost white; abdomen white with transverse drab shades on segments above; legs white outwardly irrorated with drab, the tarsi above drab with white rings. Fore wing irrorated with pale drab gray; antemedial line drab, outangled in cell, and again more so below cell, expanding somewhat on costa and above median, incurved above submedian and outbent on inner margin; some drab gray scaling on discocellular; subterminal line drab gray, double, well separated, slightly inbent, the outer line from apex; terminal dark points; cilia white. Hind wing iridescent white, faintly suffused with ecru drab; cilia white, crossed near base by a faint dark line.

Expanse 15 mm.

Habitat: Tagus Cove, Albemarle.

Type Cat. No. 26528. U. S. N. M.

Nicetiodes, gen. nov.

Male.—Antennae slightly dilated after first joint, annulate and very slightly pubescent; palpi upcurved reaching above vertex, the second joint slightly fringed below, the third smooth; frons rounded. Fore wing narrow; a fold below at base of costa with tuft of long hairs; vein 2 from close to angle of cell; 3 and 5 from angle; 4 absent; 6 from well below upper angle; 9 absent; 10 and 11 from cell. Hind wing; vein 2 from lower angle of cell; 3 and 5 stalked; 8 extremely short; on upper side near base below cell a pencil of hairs.

Type of genus *Nicetiodes apianella*, sp. nov.

Nicetiodes apianella, sp. nov.

Male.—Head, palpi, thorax and abdomen above mouse gray, the two last segments of abdomen clothed with rather long black hairs, not present in the female, the underside of body light mouse gray; legs mouse gray, the tibiae with pale rings. Fore wing fuscous; white irrorations at base, along costa postmedially and about discocellular; a narrow whitish antemedial vertical fascia; a subterminal vertical whitish line, dentate below costa to vein 5 proximally partly edged with black; cilia mottled white and gray. Hind wing white slightly suffused with drab gray, especially on termen; the hair pencil yellow; cilia white, crossed by a drab line near base. Fore wing below deep mouse gray, the hairs in costal fold black. Hind wing below white with dark suffusions on costa and termen.

Expanse 13 mm.

Habitat: Conway Bay, Indefatigable, South Seymour, Tower Island.

Type Cat. No. 26529. U. S. N. M.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

DEPARTMENT OF TROPICAL RESEARCH
WILLIAMS GALAPAGOS EXPEDITION

VOLUME V, NUMBER 3
Department of Tropical Research, Contribution Number 153

NOTES ON
GALAPAGOS LEPIDOPTERA

BY WILLIAM BEEBE

Director, Department of Tropical Research and Honorary Curator of Birds
New York Zoological Society

PUBLISHED BY THE SOCIETY
THE ZOOLOGICAL PARK, NEW YORK

January 11, 1923

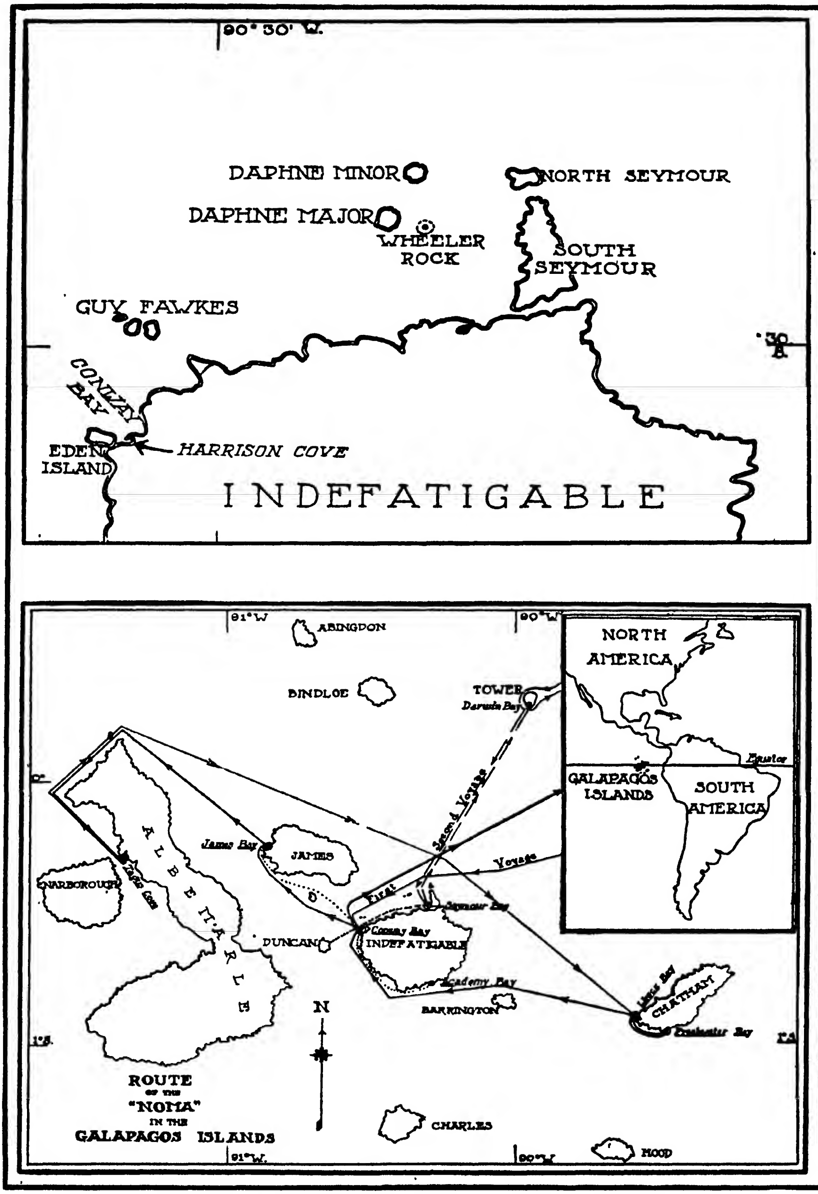

Plate A. SKETCH MAP OF GALAPAGOS ISLANDS

Route of the *Noma*, and details and location of the Archipelago.

First form on press January 11, 1924

NOTES ON GALAPAGOS LEPIDOPTERA

BY WILLIAM BEEBE

Director, Department of Tropical Research and Honorary Curator of Birds New York Zoological Society.

Suborder HETEROCERA

The contribution which the Williams Galapagos Expedition is able to make to our knowledge of the Heterocera or moths of the Galapagos Archipelago is of especial interest for several reasons, first, the unusual facility of collecting which made it possible to secure a large number of perfect specimens in the limited time available, and second, the almost absolute lack of published insular data on this group.

Nineteen years ago W. Warren described *Perixea impudens* from specimens collected by Beck on Gardner Island;[1] the following year he described *Sericosema lignata* from S. E. Albemarle,[2] and in 1911 in his report on the Expedition of the California Academy of Sciences, Francis X. Williams enumerated nine forms of Sphingidae, and casually mentioned the following six Heterocera of other families;[3]

Utehesia(*sic*) *ornatrix*
Erebus odora
Agrotis ypsilon
Meliopotis (*sic*) *nigrescens*
Meliopotis sinualis
Prodenia sp.

Although I was able to gather what seemed an unusually representative collection, yet only the first and fourth of the above

[1] Novitates Zoologicae, XI. 1904. p. 487.
[2] Ibid. XII. 1905. p. 362.
[3] Proc. Cal. Acad. Sci. (4) I. 1911. p. 319.

list were obtained by me, a hint perhaps that some species are found only during other than the rainy season.

The admirable paper which Dr. Schaus has prepared on my collection deals with six hundred and twenty-six specimens, which prove to be divisible into fifty-two species. Of these, exactly one-half or fifty per cent are new to science, while only four of the remaining twenty-six species have ever been recorded from this archipelago before. The inclusion of the microlepidoptera increases the number of specimens to six hundred and sixty-four and the species to sixty-one.

While individual moths were taken on every possible occasion on shore, yet by far the greater number were collected on board our floating home, the steam yacht Noma. We had a very powerful searchlight on the forward upper deck, a light developing about five thousand candle power, and whenever we anchored off any island, after dark this light was turned toward the nearest shore. Even when a mile away, it was so powerful that with high-power glasses we could easily distinguish figures of our party, and even small shrubs on the beach.

Within ten minutes of the focussing of the mighty shaft of light, tiny motes would become visible far down the luminous path, looking like moving flecks of gold, and in a remarkably short time the first moths would appear. Their behavior was identical, regardless of time of night, location or species. For a short time they would flutter about the glass in the full glare, and would then alight on the nearest white surface. On deck this would be the under side of the awnings, which soon were covered with a host of the little organisms. When the searchlight was turned off, the moths gradually sought other lights, the favorite being the brilliant electric glow by which we worked in the laboratory. This was the metamorphosed sun-parlor, which, painted white and with large windows opening on all sides, proved a veritable Mecca for moths. On some nights we had almost to stop work, such was the mass of insects which boarded the vessel. They clung in dense clusters about the globes, they covered the ceiling and walls, and so omnipresent were the scales from the tiny wings that any delicate microscopic work was almost impossible.

On the whole the nightly assemblage was a pure culture of moths, but there was sometimes a scattering of other insects, such as the following:

Giant female yellow and red locusts, *Schistocera melanocera* (Stål).

Large metallic green ground beetles, *Calosoma howardi* Linné. (Especially at James Island.)

A single giant brown longicorn, *Mallodon molarium* Bates.

Small black Hemiptera, Lygaeidae

Green squash Bugs, Pentatomidae

Minute green Hemiptera, Miridae (Capsidae)

Flying ants, *Camponotus planus* var. *peregrinus* Emery and var. *isabelensis* Wheeler (mss.).

Only when the wind blew very strongly off shore did any mosquitoes come on board; the moths were as abundant in a cross or even adverse wind, but on evenings of dead calm, few insects of any kind appeared.

On April 19th we were anchored two and a half miles west of South Seymour, off the northeast coast of Indefatigable. Several showers fell during the day, and in the evening we had an unusually large visitation of moths. The dominant species was *Eromene ocellea* Haworth, which I had also found common at Conway Bay. They were beautiful little creatures, fawn-colored with two orange-buff bands across the wings, and at the wing-tips was a line of silver gilt enamel drops. The yacht was inundated with them. At ten o'clock I counted seven hundred on the walls of the laboratory alone. Half an hour later there were more than twenty-five hundred on the forward awning, and on the other awnings, and boats, in cabins, smoking-, chart-, and dining-rooms there could hardly have been less than twenty or twenty-five thousand of these little exquisites, averaging about three-fourths of an inch across the wings, which had flown over two and a half miles to the source of the magnetic light. The second species in abundance was *Atteva hysginiella* Wallengren. This was also less than an inch in extent, but by far the gayest lepidopteran of the whole archipelago. Its fore wings were of a brilliant, metallic, bottle green, with purple reflections, marked with bold lines of pale yellow, and six burning spots of orange gold. There were several thousand on board, and they were conspicuous not only in pattern and pigment, but in the position which they maintained when resting. They stood high on

four legs, with the long antennae raised as high as possible, and the tip of the abdomen lowered so that it touched the surface of the wall. To a casual glance they looked much more like a beetle or a hemipter than a moth. Third in numbers was a new species, *Amyna insularum* Schaus, which at Conway Bay on the northwest coast of Indefatigable was always the most abundant, heading the list both on clear and cloudy evenings. They were dark bronzy brown with indistinct, wavy markings of black. At rest, the wings were flattened and extended backward, so that the insect was triangular in shape.

On the whole the moths which came to our lights were sombre in color, and small in size, although *Melipotis nigrescens* expands two inches, and *Beebea guglielmi* reaches two and a quarter inches.

As to the origin of this fauna I shall have more to say in another paper, but heie I will mention that of all the non-autochthonous species, not one is exclusively confined to the South American continent, but all range as far north as Costa Rica, and some even to the United States, while a considerable number are altogether Central American.

Walking through the undergrowth or short grassy plants on shore, small moths continually flew up from one's path, but the species more particularly diurnal and active even at high noon in brilliant sunshine were the bright-colored *Atteva hysginiella* and *Eromene ocellea.* These haunted the yellow flowers of *Cordia, Cassia* and *Gossypium* in large numbers, in common with a butterfly, *Callidryas eubule*, a beetle, *Oxacis*, and a green-winged hemirobiid.

As to the relations between Heterocera and other members of the Galapagos fauna, the smaller species of moths are frequently devoured by purple martins, flycatchers and mockingbirds, and less often by *Tropidurus* lizards (four records), and the common snake *Dromicus dorsalis* (one record).

Family SPHINGIDAE

To continue the enumeration of the Heterocera of the Galapagos, Williams, as I have said, has recorded nine forms of sphinx moths from this archipelago. Of these I obtained only four;

62 *Deilephila lineata* Fab.

3—South Seymour.

63 *Dilophonota obscura conformis* Roth. & Jordan.

2—South Seymour, Conway Bay.

64 *Phlegathontius galapagensis nigrita* Roth. & Jordan.

1—South Seymour, Tagus Cove.

65 *Herse cingulata* Mer.

1—South Seymour.

Only *conformis* and *cingulata* ever flew on board at night to the light and that very rarely. The white-lined sphinx, *Deilephila lineata,* was decidedly diurnal, and all day in the brightest sunshine it could be found hovering before small blossoms. Twice, on South Seymour, I saw purple martins pursuing and catching and feeding upon this hawk moth. I obtained many specimens of *nigrita* from cobwebs on Indefatigable and Albemarle, as well as other unidentifiable species. Every morning there would be a new lot, visible as oblong, web-swathed moth mummies, apparently suspended in space between the bushes.

Suborder RHOPALOCERA

Six species of butterflies have been recorded from the Galapagos. Four of these I found to be common almost everywhere I explored.

1—*Callidryas eubule* Linné.

New localities,—Eden, Daphne, South Seymour.

2—*Agraulis vanillae galapagensis* Holland.

New localities,—Eden, South Seymour.

3—*Cupido parrhasionides* Wallen.

New localities,—Indefatigable, Eden, South Seymour.

4—*Eudamus galapagensis* Williams.

New localities for specimens,—Indefatigable, James, Eden, South Seymour.

I can add one new species to the Galapagos fauna,

5—*Danais plexippus* (Linné)

On April 7th two of these unmistakably familiar butterflies flew slowly about us near the shore at Freshwater Bay, on the south side of Chatham, when we were siphoning off a boatload of water. Three of us saw the insects, but we had no opportunity of capturing them.

Two phases of butterfly life in the Galapagos seem worthy of record,—the butterfly diet of some of the birds, and the migration of *Callidryas eubule.*

My first hint of the lepidopterophagus habits of the birds of

these islands was on the small island of Eden off the northwest coast of Indefatigable. I had been interested in watching a half dozen nests of the Galapagos purple martin, *Progne modesta,* when a yellow butterfly, *Callidryas eubule,* fluttered slowly down over the cliff toward us, and at once a martin set off in pursuit. It was a long zigzag chase with the "sulphur" trying to dodge, now down to the water, back to shore, and around in spirals,—a veritable whirling bit of yellow tissue. At last an unlucky turn fairly shot the insect into the mouth of the martin and the bird flew about for a full minute before the wings disappeared, either dropped to the ground or swallowed.

Urged by Professor Poulton, I have for many years kept on the watch for instances of birds attacking butterflies, as considerable weight of certain mimicry and color theories depends upon butterflies having aerial enemies. That lizards often devour these insects is well known, but a bird as assailant is a rarer event. In Ceylon and in Burma, in the high Himalayas, and in central China I have occasionally seen such pursuits, but they were seldom successful, and often appeared to be mere half-hearted, sporting activities, a pitting of wing power against a worthy opponent, as birds will pursue each other in mid-air. I have seen many thousands of opportunities neglected, where migrating butterflies were passing scores to the second in sight, with flycatchers and swallows hawking about, wholly indifferent to this abundant but fuzzy source of food.

Seventeen years ago E. W. Gifford[4] made four notes on this subject, writing of the martins of Tagus Cove, Albemarle. He says,—

> "I saw one with a butterfly in its mouth being pursued by two others."
>
> "I saw one enter its nest with a medium sized yellow butterfly in its mouth."
>
> "I saw one make a dozen or so unsuccessful attempts to catch a yellow butterfly which was crossing the cove."
>
> "On April ninth, I noted one chasing a sphinx moth over Tagus Cove; the moth finally dropped into the water and the bird left it."

Stimulated by the observation which I had made so early in my visit to the islands, I kept on the watch, and for the first time

[4] Proc. Cal. Acad. Sci. (4) Vol. II. No. 13. 1919. pp. 206–207.

in my life I found aerial birds which fed largely on butterflies and moths. Within five minutes after my first martin-butterfly incident, I saw two others chasing a red butterfly which they failed to capture. The first butterfly and at least two of those mentioned by Gifford were *Callidryas eubule*, almost identical with our northern forms, and the reddish one was the fritillary, *Agraulis vanillae galapagensis*. During the ensuing twenty days which I spent on the islands I made notes of thirteen additional instances of the same character, twelve of the victims of which were *Callidryas*, and the other one *Agraulis*.

Not only this, but when I returned to the Noma from the first trip to Eden and examined the food of the martins I had taken, I found that both the young fledgling and its male parent had been feeding almost entirely upon small moths. Two wings of a larger specimen were still recognizable as a new species of moth, *Melipotis harrisoni* Schaus. The nestling had been fed twelve, and the parent had himself eaten at least twenty-one moths,—all small, all dull in color. At another island, South Seymour, as I have already mentioned, I saw the same species of bird pursuing and feeding on a small diurnal sphinx moth, *Deilephila lineata*.

It is a usual thing for cuckoos of various species to feed upon hairy caterpillars and other unpleasant-appearing provender, but it is not common for diurnal birds to be willing to devour such fuzzy creatures as are these millers. I remember in Garhwal, high up in the Himalayas, half round the world, I have shot white-crested kaleege pheasants with their crops stuffed with two or three dozen small moths, all swallowed whole and quite identifiable. Both the mockingbirds and flycatchers of the Galapagos were expert and willing butterfly catchers. All this is in very decided contrast to what obtains elsewhere, for in my experience, the relation between birds and butterflies is quite a negligible factor in any lepidopterous theory of evolution of pattern, color, form or activity. With fat, winged and wingless grasshoppers of all sizes so abundant everywhere in these islands, the diet of butterflies became all the more inexplicable.

On April 23rd I left the yacht and took a motorboat five miles to Daphne Major, off the northeast coast of Indefatigable. When halfway to the island *Callidryas eubule* began to pass us, and recalled that on three previous days and once on my first voyage to the archipelago I had observed a similar migration. It is a common

but mysterious habit in mainland representatives of closely related forms, and in British Guiana often takes place on an extraordinary scale.[5]

There, the usual direction was north-northwest; here it seemed invariably southeast. On Indefatigable I watched it two days in succession, the insects flying low over the water from the direction of James and Albemarle and continuing due southeast across cactus and craters. Again on the backbone of Seymour I saw many keeping on their course straight out to sea in the teeth of the trades, headed for Chatham, and finally in Freshwater Bay on the south shore of Chatham, brave little "sulphurs" were fluttering past on their inexplicable compass-true path headed for the open sea and certain death. Yet all around were others flying from cotton-blossom to the blooms of the *Cordia*,—each as yellow as their own wings,—paying no heed to their travel-stricken fellows in mid-air. Soon, perhaps, they in their turn would follow. The Galapagos martin has abandoned all his migrations, the sulphur butterflies of these islands are still slaves to an instinct which seems to us unreasonable. useless, almost inimical.

One other interesting butterfly migration was observed in the Galapagos, when we were at anchor in James Bay. On shore *Agraulis* was about as abundant as the black skippers, *Eudamus galapagensis*, and both were living in the same high, open, weedy places at the base of the mountain. When on shore I saw no signs of a concerted movement among any of the species, the *Agraulis* flying slowly from flower to flower, or resting on leaves, waving their wings in the sun.

About seven o'clock in the morning of April 5th a strong migration of the *Agraulis* began, visible from the deck of the Noma, two miles off shore. As far as my eyes or my glasses could reach in all directions, the red and black butterflies were seen flying steadily and quite rapidly from southeast to northwest,—in exactly the opposite direction from that which the migrating *Callidryas* took near Indefatigable. Although these butterflies flew well apart, I counted three hundred and sixteen within a short time, and caught six on deck. After breakfast, and later when we left at nine o'clock, the migration was going on as strongly as ever. If maintained, this line of flight would carry the insects parallel to Albe-

[5] Edge of the Jungle, 1921, pp, 259–262,

marle, out into the open Pacific, with only the tiny specks of Culpepper and Wenman far to the northwest, islets from which this species of butterfly has never been recorded.

Whenever there is variation of Galapagos lepidoptera from closely related mainland forms, it is usually in the direction of a reduction in size and a darkening or melanism of the colors in general. This is especially noticeable in the white-lined sphinx *Deilephila lineata*, and in *Agraulis galapagensis*. Unless the coastal stock is constantly derived and replenished from the more humid zone of the interior of the islands, it is difficult to account for the darkening of specimens, the entire coastal zone being semi-arid. The reduction in size may be due to insufficient nourishment on the part of the caterpillars, for except at the height of the brief rainy season they must often be hard put to it to find sufficient green leaves for food.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

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DEPARTMENT OF TROPICAL RESEARCH
WILLIAMS GALAPAGOS EXPEDITION

VOLUME V. NUMBERS 4–16.

Department of Tropical Research
Contribution Numbers 154–162 and 165–169.

Collected by The Williams Galapagos Expedition

PUBLISHED BY THE SOCIETY
THE ZOOLOGICAL PARK NEW YORK

February 27, 1924

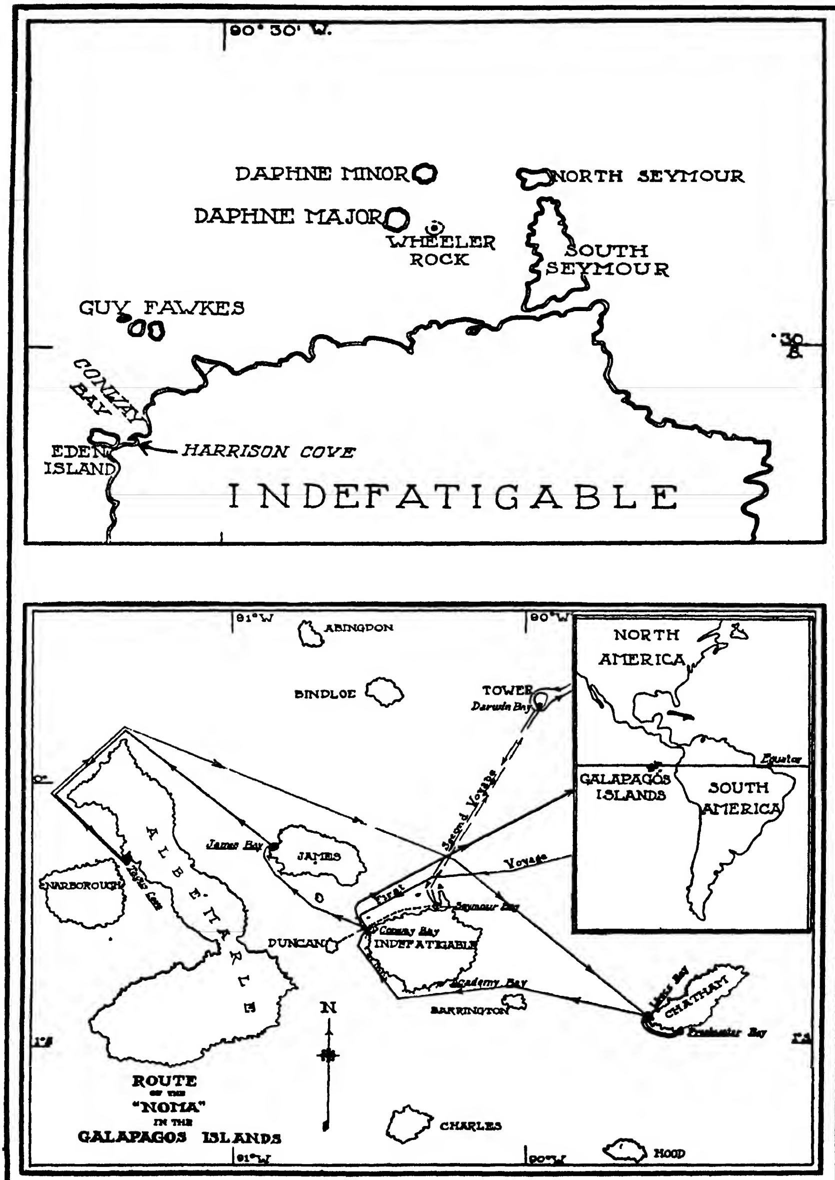


Plate A. SKETCH MAP OF GALAPAGOS ISLANDS

Route of the *Noma*, and details and location of the Archipelago.

First form on press February 27, 1924

A CONTRIBUTION TO THE ICHTHYOLOGY OF THE GALAPAGOS.

BY J. T. NICHOLS.

(Figure 11).

The American Museum of Natural History has recently received, through Mr. William Beebe, Director of the Harrison Williams Galapagos Expedition of the Department of Tropical Research, New York Zoological Society, an interesting collection of marine fishes from the Galapagos Islands, made in 1923.

Various fish collections have been made in these islands in past years, but these have been of a fragmentary nature, and the fishes of the islands are still imperfectly known. Two undescribed forms have been found in the present material, and two or three others, known from neighboring seas, deserve special mention, as follows:

Cypselurus nigricans (Bennett). Bennett, 1840, described this flying fish from "both the Atlantic and Pacific Oceans, in lat. 5° N." It is close to *Cypselurus furcatus* (Mitchill) 1815, New York. Recent authors have recognized *furcatus* and *nigricans* as distinct species both occurring in the Atlantic, but it is probable that Atlantic material referred to each is identical; and as the fish to hand agrees with Bennett's description, and is almost certainly what he had from the Pacific, his name is available for it.

It is 215 mm. in length to base of caudal, longest dorsal ray ½ head. Dorsal, 14; anal, 11. Pectorals blackish with a diagonal white stripe and white edging; dorsal pale with a black blotch between the 5th and 11th rays; ventrals pale with slight indication of dusky shading; anal pale; caudal dusky with a pale margin.

Haemulon scudderi (Gill). A specimen about 13 cm. long, from South Seymour I., of this common grunt of the west coast from Mexico to Panama, seems to be the first definite Galapagos record. On *a priori* grounds it was to have been expected there, but not necessarily so, as grunts are not very strong swimmers.

Eupomacentrus beebei[1] sp. nov.

The type, our only specimen, No. 8270, American Museum of Natural History, was collected in a rock pool at Eden, Indefatigable Island, April 1, by the Williams Galapagos Expedition, 1923. It is illustrated in a colored plate in the narrative volume of the Williams Expedition; "Galapagos; World's End," by William Beebe, published by Putnam.

[1] Named for William Beebe in view of his appreciation of the interest and beauty of a tropical reef and its brilliant fishes.

First form on press February 27, 1924.

It has a very striking color pattern as follows: in the alcoholic specimen dusky all round including pectoral and lower fins; center of top of head, top of back and spinous dorsal, orange (later fading to whitish); soft dorsal grey with a dusky base. A large black blotch surrounded by a blue ring on last two spines and anterior soft rays of dorsal, and extending onto the back below. Peduncle pale; caudal grey.

Length to base of caudal, 15 mm. Depth in this length, 1.8; head, 2.3. Eye in head, 2.4; interorbital, 3.0; maxillary, 4.5; depth of peduncle, 2.5; pectoral, 1.4; ventral, 1.3; longest dorsal spine, 2.7; longest dorsal ray, 2.1; longest anal ray, 2.2.

Upper and lower profiles of body about equally arched, forehead moderately steep and rounded. Tips of ventrals filamentous. Caudal with a shallow fork. Dorsal XII, 15, anal II, 14. Scales, 29.

There are light blue marks on the head, including a mark from snout to over front of eyes, thence, after a short break, continued back to nape. A spot in the mid-line between the eyes opposite the break in the above-mentioned mark. A blue spot on the base of the soft dorsal, and a blue spot bordered behind with dusky in its axil. Two blue spots followed by a blue stripe on the base of the anal. Some of the scales on sides faintly barred with blue. A color sketch from life has electric blue sides and a scarlet back.

There is nothing like this little fish described in the genus *Eupomacentrus*, where it seems to belong. Young Pomocentrids are at times very deceptive, and it should be noted that we have not seen so small a specimen of *Hypsypops rubicundus*.

Teuthis crestonis (Jordan and Starks).

A large surgeon fish from Indefatigable I. falls within probable individual variation for this species, found from Mexico to Panama. Its caudal is well forked, the upper lobe longest and narrow; color all round dusky, except a yellow margin to the pectoral fin.

Runula albolinea sp. nov.

Differs strikingly in color from *Runula azalea* with which it has been directly compared (specimens from Cape San Lucas). No alternate black and white cross marking on the fins as in that species. A narrow white line from over eye to upper caudal origin.

The type, No. 8271, American Museum of Natural History, was collected on Indefatigable Island by the Williams Galapagos Expedition, 1923. It is 43 mm. long to base of caudal. Depth contained 6.5 times in this length; head 4.5; snout and eye equal, 3.5 in length of head; width of mouth, 3.0; pectoral, 1.7; ventral, 2.6; caudal, 1.2; forked for about half its length. Dorsal beginning on the nape; its rays, 41; anal, 28.

Color in alcohol pale greyish to the level of the lower margin of the pupil, white below that line. A narrow white line passing over eye is continued back to the upper caudal origin, and there is another similar white line on the center of the head before dorsal. Dorsal, with a narrow pale edge subtended by a dusky stripe which broadens to tinge all but the base of the central half of the fin; other fins pale.

FIG. 11 *RUNULA ALBOLINEA* sp nov

A second example is of the same size and similar in every respect. Four other specimens measure from 35 to 46 mm. in standard length. The largest of these, which has been figured by Miss Isabel Cooper, is somewhat deeper. The color pattern of all is the same. All are from Conway Bay, on the northwest coast of Indefatigable Island, which island is also the type locality of *R. azalea.* It would seem more probable that the *Runula* from the coast would differ from that in the islands, than that a second species should occur in the islands where *R. azalea* was originally described. However, Cape San Lucas material examined agrees with the type description of *azalea,* and *albolinea* neither with that description nor with Cape San Lucas material.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

APTERYGOTA OF THE WILLIAMS GALAPAGOS EXPEDITION

BY J. W. FOLSOM.

(Plates III–V incl.).

The Apterygota collected by the Williams Galapagos Expedition sent out by the Department of Tropical Research, of the New York Zoological Society, and forming the subject of the present report, are as follows:

Heterolepisma intermedia sp. nov.
Acrotelsa galapagoensis Banks.
Lepidocyrtus intermixtus sp. nov.

The two species of Thysanura were collected by Professor W. M. Wheeler, and the single species of Collembola by Mr. William Beebe.

Types and other specimens are in the collections of the Department of Tropical Research of the New York Zoological Society.

Five species of Apterygota are now known from the Galapagos Islands, the Hopkins Stanford Expedition, 1898–1899, having taken three species, which were described by Mr. Nathan Banks. One of these three (*Acrotelsa galapagoensis* Banks) was present in the Williams collection, but the two others (*Lepisma insularis* Banks and *Machilis mutica* Banks) were not.

Heterolepisma intermedia sp. nov.

(Plate III, figs. 1–8; Plate IV, figs. 9–12).

Dorsally grayish or brownish with the scales; ventrally whitish; body color yellowish white. Legs whitish or spotted with brown or purplish, with yellow setae. Head short and broad. Thorax in width to height as 10:7; thoracic nota subequal; pronotum not strongly narrowing anteriorly, subquadrate with rounded angles. Body elongate, almost parallel-sided throughout, sub-cylindrical, dorsally strongly convex. Abdomen narrowing but slightly posteriorly, almost twice as long as the thorax (as 13:7). Tenth urotergite (figs. 1, 2) four times as long as the ninth, trapezoidal, with posterior angles rounded and posterior margin slightly concave. Antennae white, spotted with brown or purplish, the spots forming annulations in large specimens; length of antennae unknown.

First form on press February 27, 1924.

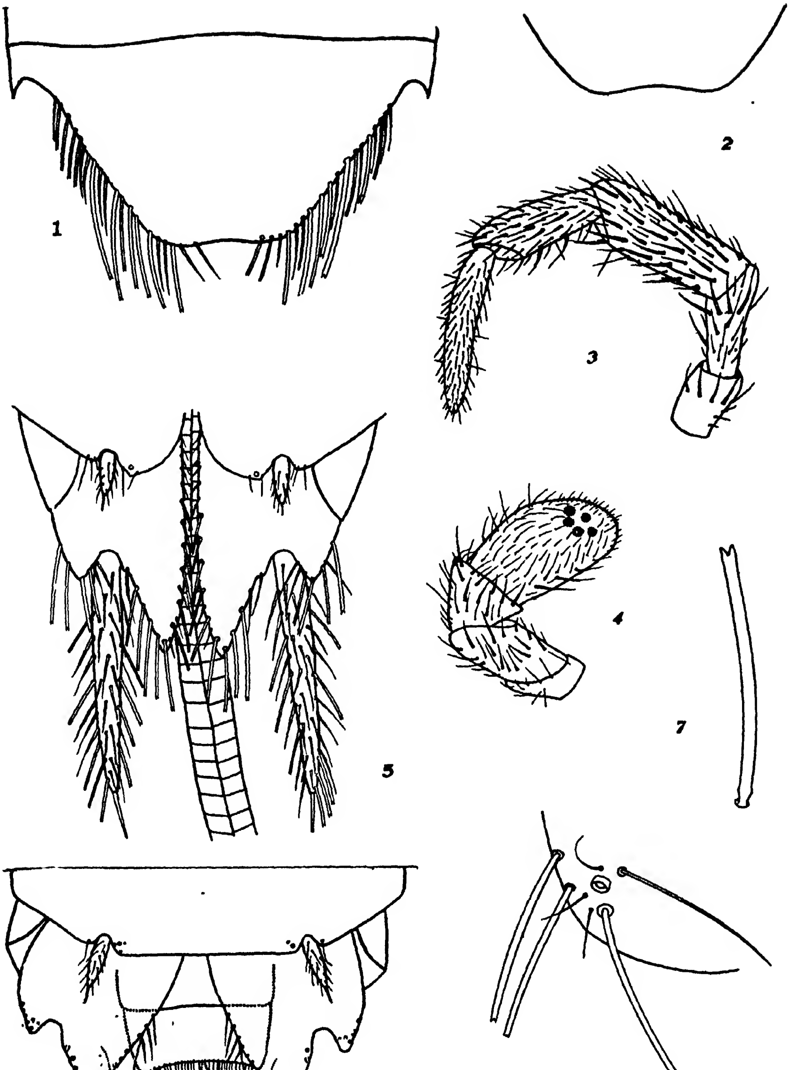


Plate III. 1, *Heterolepisma intermedia*, telson of female, × 80. 2, *Heterolepisma intermedia*, extremity of telson of male, × 80. 3, *Heterolepisma intermedia*, right maxillary palpus, × 100. 4, *Heterolepisma intermedia*, left labial palpus, × 100. 5, *Heterolepisma intermedia*, ventral aspect of extremity of abdomen of female, × 53. 6, *Heterolepisma intermedia*, ventral aspect of extremity of abdomen of male, × 53. 7, *Heterolepisma intermedia*, seta from front, × 370. 8, *Heterolepisma intermedia*, setal cluster of left postero-lateral angle of pronotum, × 175.

Palpi whitish, tinged with brown or purplish, with yellow setae. Maxillary palpi (fig. 3) with last four segments pigmented apically. Labial palpi (fig. 4) with last three segments pigmented faintly; last segment stout, subclavate, with five rounded papillate sense organs (fig. 4). Cerci of unknown length. Styli (fig. 5) two pairs, on eighth and ninth abdominal segments, respectively; white with yellow setae; styli of ninth segment long and large; those of the eighth small. Ovipositor (fig. 5) rod-like, tapering apically, extending beyond the paramedian processes a distance equal to four times the length of the latter; dorsal and ventral valves pseudosegmented. Paramedian processes (fig. 5) each extending not quite to the middle of the adjacent stylus; shorter and broader in the male (fig. 6) than in the female. Eighth urosternite undivided in the male (fig. 6).

All the setae are naked. Most of the setae of the head and body are bilobed apically (fig. 7), straight or slightly curving, and of different sizes. They are numerous on each side of the front, on the sides of the head, above the bases of the antennae, and on the posterior part of the abdomen. On the lateral margins of the thorax are sparse short setae, with occasional long setae. Each thoracic notum has 2 + 2 setal clusters or combs: at each postero-lateral angle a cluster (fig. 8), and on each side of the posterior margin a comb consisting of one macrochaeta between two small setae. Abdominal segments one to seven, inclusive, bear 3 + 3 setal combs: inner dorsal, outer dorsal and lateral (figs. 9–11); abd. 8, 2 + 2, dorsal and lateral; abd. 9 and 10, none. The macrochaetae of the combs are reduced in number as compared with those of most other species. Thus the inner dorsal comb has but one large seta between two small ones (fig. 9); the outer dorsal, two or three macrochaetae (fig. 10); and the lateral comb, two (fig. 11). Ventrally, abdominal segments two to seven, inclusive, bear 1 + 1 combs, each comb consisting of two (rarely three) macrochaetae between two small setae (fig. 12). On the eighth abdominal segment there is one (sometimes two) macrochaeta on the mesal side of the articulation of the stylus (figs. 5, 6). In the specimens most of the macrochaetae of the clusters and combs had fallen off, but were represented by their sockets, as shown in the figures.

Scales oval, orbicular, suboblong, subelliptical, etc., being very variable in form; very finely striate; pale brown or colorless.

Length, 5.5 mm.; width, 1 mm.

Eleven syntypes. Indefatigable, April 19th, under roots of *Bursera*, five males and four females, W. M. Wheeler (No. 2262). South Seymour, April 22nd, sifted from soil near beach, one male and one female, W. M. Wheeler (No. 2297).

In its generic characters this species is intermediate between *Isolepisma* Esch. and *Heterolepisma* Esch. It agrees with the former genus in its arched dorsum and long telson, and with the latter in its subquadrate pronotum, scarcely narrowed anteriorly, and the general character of its setal clusters and combs. It seems preferable to refer this species to *Heterolepisma*, rather than to erect a new genus for it.

H. intermedia is nearly related to the neotropical species *H. pampeana* Silv., recorded from Buenos Aires, Rio S. Cruz and Porto Piramides, and reported to be abundant on the pampas of Patagonia.

Plate IV. 9, *Heterolepisma intermedia*, right inner dorsal setal cluster of the third abdominal segment, × 370. 10, *Heterolepisma intermedia*, right outer dorsal setal comb of the fifth abdominal segment. The macrochaetae are represented only by their sockets, × 370. 11, *Heterolepisma intermedia*, right lateral setal comb of the third abdominal segment, × 370. 12, *Heterolepisma intermedia*, right ventral setal comb of the sixth abdominal segment, showing one of the two macrochaetae, × 175. 13, *Acrotelsa galapagoensis*, telson of female, × 25. 14, *Acrotelsa galapagoensis*, left maxillary palpus of female, × 25. 15, *Acrotelsa galapagoensis*, left labial palpus of female, × 20. 16, *Acrotelsa galapagoensis*, ventral aspect of extremity of abdomen of female, × 25. 17, *Acrotelsa galapagoensis*, ventral aspect of extremity of abdomen of male, × 34.

Acrotelsa galapagoensis Banks.

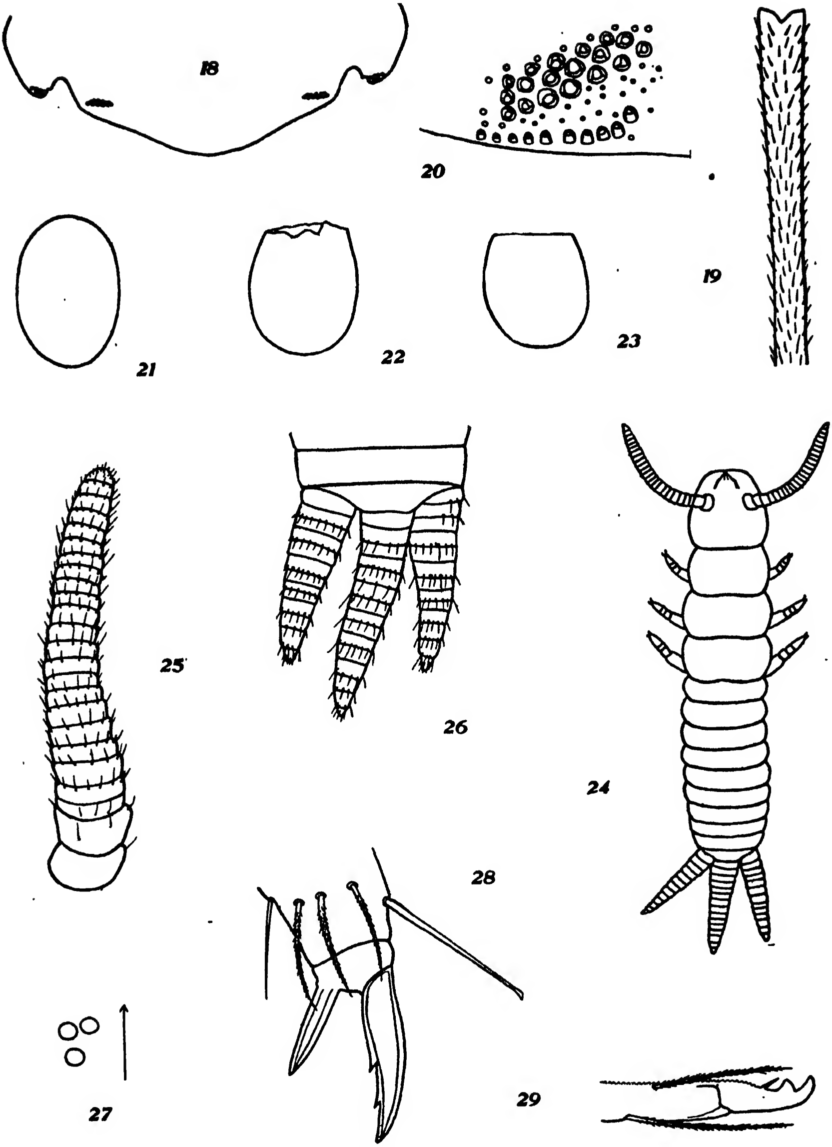
Lepisma galapagoensis Banks, 1901.
Proc. Wash. Acad. Sc., Vol. 3, pp. 541–543, *figs.* 47–50.

(Plate IV, figs. 13–17; Plate V, figs. 18–20).

This giant lepismid described by Banks was represented in the collection by five specimens, the study of which has enabled me to add certain details to the original description.

Dorsally dark brown; mottled with dark brown, pale brown or grayish scales; body color white. Ventrally silvery white; or with yellowish white thorax and brownish abdomen. Legs golden brown proximally, pale yellow distally, with brown scales and yellow or yellowish brown setae. Head short and broad, rounded anteriorly; eyes not prominent. Thorax broader than the abdomen; pronotum rounded laterally, narrowing anteriorly. Abdomen narrowing slightly posteriorly. Tenth urotergite (fig. 13) elongate-subtriangular, apically acute, fringed with stiff yellow setae. Antennae longer than the head and body by one third; annulated with dark brown and white. Maxillary palpi (fig. 14) white with brown setae (female) or brownish with last three segments darker (male); with segments in relative lengths as 3:5:7.5:7:8 (female) or as 3:5:7:5:13 (male). The fifth segment in Bank's figure is probably abnormally short. Labial palpi (fig. 15) white with brown setae (female) or pale brown (male); last segment foot-shaped. Cerci and pseudocercus dark brown, annulated with white or yellowish white; the former three fourths as long as the head and body; the latter somewhat longer than the cerci. Styli (figs. 16, 17) seven pairs, on third to ninth abdominal segments; slender, white with brown setae (female) or brownish with golden brown setae (male). Dorsal and ventral valves of ovipositor subequal in length. Ventral valves (fig. 16) finger-shaped in ventral aspect, obliquely pseudosegmented, extending almost as far as the adjacent paramedian process of the ninth gonocoxite; this process (figs. 16, 17) tapering uniformly to an acute apex, and extending two fifths as far as the adjacent (last) stylus in the female, and one third as far in the male. Eighth ventral segment divided in the female, forming a pair of gonocoxites (fig. 16), undivided in the male (fig. 17). Seventh ventral segment (fig. 18) undivided, rounded posteriorly, without a median fold on the posterior margin. Parameres of male (fig. 17) subclavate, extending as far as the adjacent paramedian processes of the ninth abdominal segment.

Stiff, minutely fringed setae, apically bilobed (fig. 19) occur abundantly; most of them being yellow, though some are brown. On the head are "fourteen tufts of hair seen from above as follows: one in front of each eye, one behind each antenna, two above base of each antenna, one in front of each antenna, and two each side on anterior margin; below on clypeus there are other tufts" (Banks). Marginal clusters of these bilobed setae occur on the thoracic terga, occupying the yellowish pores mentioned by Banks. Each thoracic notum bears seven or eight lateral clusters of setae, the last cluster being at the postero-lateral angle, and bears in addition, near the posterior margin, 1 + 1 dorsal combs. The combs are simply clusters in which the setae are in alignment, as in figure 17. On the abdomen, in dorsal aspect, the following setal combs or clusters are visible: abd. 1, 2 + 2; abd. 2–7, 3 + 3; abd. 8, 2 + 2; abd. 9,



. Plate V. 18, *Acrotelsa galapagoensis*, ventral plate of seventh abdominal segment of female, × 14. 19, *Acrotelsa galapagoensis*, seta from front, × 240. 20, *Acrotelsa galapagoensis*, setal sockets of left outer dorsal comb of fourth abdominal segment, × 110. 21, *Lepismid*, outline of egg, × 15. 22, *Lepismid*, egg shell, × 15. 23, *Lepismid*, egg shell, × 15. 24, *Lepismid*, nymph, reconstructed from exuviae, × 25. 25, *Lepismid*, right antenna of nymph, × 100. 26, *Lepismid*, telson, cerci and pseudocercus of nymph, × 53. 27, *Lepidocyrtus intermixtus*, eyes of left side, × 320. 28, *Lepidocyrtus intermixtus*, right hind foot, × 1260. 29, *Lepidocyrtus intermixtus*, left mucro, × 1260.

1 + 1; abd. 10, 3 + 3 large marginal clusters and sometimes a small fourth distal pair (fig. 13). Of these just enumerated, lateral clusters occur on abd. 1–9 inclusive. Most of the clusters and combs contain many macrochaetae (fig. 20). The thoracic sternites are fringed with stiff yellow setae; the prosternum has three combs on each side, the meso- and metasternum each two. On the abdomen, ventrally, there is a setal cluster on each side of the articulation of each stylus on abd. 3–7, inclusive (fig. 18), the mesal clusters forming combs; and a mesal comb on abd. 8 (figs. 16, 17).

Scales simple, varying greatly in form: obovate, ovate, suboval to orbicular, etc., very minutely striate. The scales are sometimes colorless but usually pigmented with brown, especially apically; the fine close striae give interference colors of violet or blue.

Length of largest female, 18 mm.; width of mesonotum, 5 mm.; length of antennae, 25 mm.; of a lateral cercus, 15 mm.

Length of largest male at hand, 9 mm.

Six specimens, collected by Prof. W. M. Wheeler. Two females, Indefatigable, April 8th, 22nd, under stones on beach (Nos. 2188, 2306). One female, Daphne Major, April 24th (No. 2333). One male, South Seymour, April 25th, (No. 2423). Two males, James Island, April 5th (pinned).

The types described by Banks were taken on Hood Island in May.

A. galapagoensis is closely related to the West Indian species *A. gigantea* Esch., as regards the number of styli, the form of the labial palpus, etc., but differs from the latter species in regard to the color of the legs, styli and palpi, and in some other respects, particularly in having no median fold on the posterior border of the seventh ventral plate of the female.

The genus *Acrotelsa* contains the largest known lepismids. *A. gigantea* Esch. attains a length of 21 mm., and *A. galapagoensis* Banks, 20 mm.

Lepismid Eggs and Nymphs.

(Plate V, figs. 21–26).

Mr. Beebe collected, on South Seymour Island, April 22nd, hundreds of egg shells, which were at the time correctly identified by Professor Wheeler as lepismid. These were found under a slab of lava rock upon a small amount of earth. They were not attached to the stone but were loose, on and in the thin layer of soil.

These were shells of eggs that had hatched. Among them was rarely an unhatched egg, like that represented in figure 21. The shells are brownish yellow, the eggs broadly elliptical to subovate, and smooth externally. At one end, the narrower end of the subovate egg, the nymph escapes by pushing off a cap, leaving usually an irregular torn margin (fig. 22), though occasionally a straight edge (fig. 23), indicating a pre-existing line of weakness. The eggs average 1.45 mm. in length by 0.9 mm. in width. Frequently several egg shells are held together in a cluster by means of a gelatinous substance.

Among the egg shells were hundreds of minute lepismid skins, and occasionally a skin of the same kind could be seen within an egg shell. These skins had all belonged to nymphs of practically the same size and were probably exuviae of the first molt. The more complete skins showed a median dorsal split extending always the length of the head and thorax and frequently to the end of the abdomen. Though all the skins were more or less distorted and fragmentary, it was not difficult to reconstruct from them the form of the nymph, shown in figure 24.

As little is known about the early stages of lepismids, except what Heymons has recorded, it is worth while to describe this immature form, in comparison with adult lepismids.

The head is very large in proportion to the body. The thoracic segments are equal and simple, and the thorax but slightly broader than the abdomen; the latter being only one fourth longer than the thorax, with parallel sides scarcely narrowing posteriorly, and with segments mostly subequal. There is no imbrication of the abdominal sclerites, which simply meet, edge to edge. In the exuviae, at least, there are no traces of external organs of reproduction, with the exception of a median slit dividing the ninth ventral segment into halves almost to the posterior border of the eighth. The mouth parts are peculiar, forming a cone; there being an enclosing ventral sheath (probably the labium, as in Hemiptera) which is split along the median dorsal line—a condition that I have not as yet encountered in any adult lepismids. The antennae (fig. 25), inserted close together, are short and stout, only three fifths longer than the head, with twenty-four segments (the adults would have very many), the segments being mostly subequal in length. The cerci and pseudocercus (fig. 26) are slightly longer than the head, stout, and elongate-conical; the cerci having thirteen segments (rarely twelve) and the pseudocercus fifteen (the adults would have many more). There are no traces of styli. The legs have short stout segments, like those of an embryo; the tarsus bearing three claws, as in all lepismids. The setae of the body and legs are sparse, short and stiff. No scales are present, though the cuticula is elevated into minute, closely-set papillae.

Characters of generic value are practically absent in these nymphs; though they might possibly be found in the mouth parts. The form of the telson is one common to many genera of Lepismidae.

Clues to the identity of these nymphs were found, however, in two cast skins of well-grown individuals that occurred among the egg shells and small exuviae. These two larger skins were far from perfect, but showed the same peculiar kind of mouth parts and the same form of telson found in the smaller skins; and exhibited, moreover, well developed setal combs, in which the macrochaetae were still in place. These large setae were exceptionally long, bilobed apically, and strongly fringed. The large skins showed lepismid eyes, of which I did not detect any traces in the small exuviae; corneae may have been present in the latter, but if so, were obscured by foreign matter and by the distortion of the cuticula. There were seven pairs of styli.

The eggs and nymphs do not belong to either of the two species of lepismids described here; for the form of the telson excludes them from *Acrotelsa* and the fringed setae from *Heterolepisma*. The number of dorsal setal combs, the number of macrochaetae in each comb (inner dorsal, 2; outer dorsal, 4 or 5; lateral, 4 or 5) and the number of styli, indicate that the species belongs in or near the genus *Ctenolepisma*.

Lepidocyrtus intermixtus sp. nov.

(Plate V, figs. 27–29).

White throughout (excepting the black eye-spots), or white with a faint pigmentation of irregular spots of blue, frequently surrounding colorless round or oval spots made by the hypodermal nuclei. The pigment consists of minute round separate granules of blue, and when present occurs scatteringly on the following regions: head, dorsally, laterally and ventrally; an imperfect V-shaped line connecting the ocular spots anteriorly; mesonotum, antero-dorsally and laterally; metanotum, dorsally and laterally; abd. 1–3, a feeble pigmentation dorsally and laterally; abd. 4, dorsally except on anterior fourth, laterally, also ventrally on each side of the middle region; abd. 5, a little pigmentation dorsally. Antennae white throughout, or all segments spotted with blue but colorless apically. Legs slightly pigmented basally, otherwise colorless. Furcula white throughout.

Eyes (fig. 27) three on each side, equal, not on separate pigment spots, but on a common black spot, which is small and roughly elongate-triangular. Antennae slightly longer than the head, with segments in relative lengths about as 10:16:17:33; first two segments subcylindrical, third subclavate, fourth narrowly elliptical. Mesonotum covering the prothorax but not projecting over the head; with a dense anterior fringe of divergent setae, feebly clavate and naked. Fourth abdominal segment more than twice as long as the third (from 2.1 to 2.6 times as long). Fifth and sixth abdominal segments with curving fringed setae. Claws minute. Unguis (fig. 28) almost straight, without lateral teeth, with inner margin subequally bidentate, there being one tooth in the middle and an-

other one fourth from the apex. Unguiculus extending as far as the proximal tooth of the unguis, straight, sublanceolate. Tenent hair feebly knobbed. Furcula attaining the ventral tube. Manubrium and dentes subequal in length, with short curved fringed setae dorsally, and scales ventrally. Dentes crenulate dorsally on the proximal three fourths, the distal fourth bearing minute serrations, which are continued beyond the dens on the dorsal side of the mucro (fig. 29). Mucro minute, tridentate; apical and anteapical teeth subequal; proximal tooth oblique as usual, spine-like, in the middle of the dorsal margin. A few long fringed setae extend from the dens nearly or quite to the end of the mucro.

A dorsal pair of erect subclavate fringed setae was seen on the second abdominal segment of one specimen, and such sensory setae doubtless occur normally on other segments also. Very few scales had remained on the specimens; these scales were oval or elliptical, with obscure, extremely minute and close, short, irregular, longitudinal striae. Maximum length of specimens, 1 mm.

Twenty-two syntypes. South Seymour Island, April 22nd. This little collembolan was taken incidentally by Dr. William Beebe; it appeared among the hundreds of lepismid egg shells that he collected.

This form, like a few other species of *Lepidocyrtus*, approaches the genus *Sira* as regards the shortness of the mesonotum. As the furcula bears ventral scales, however, the species is referred to *Lepidocyrtus*.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

HOMOPTERA OF THE WILLIAMS GALAPAGOS EXPEDITION.

BY HERBERT OSBORN.

The few species of Homoptera submitted for examination were collected by William Beebe in the Galapagos Islands, and are interesting as bringing to light a species long ago described by Stål with some closely related forms, and also a species of *Jassus* not hitherto known from these islands. The Williams Galapagos Expedition was sent out by the Department of Tropical Research of the New York Zoological Society.

Jassus galapagoensis sp. nov.

Head broad, blunt; vertex, female, nearly twice as wide as long, narrower in male, faintly carinate; ocelli close to border, not sunken in pits; front narrow, rather faintly carinate; clypeus twice as long as width at base, expanding toward tip. Pronotum a little longer than vertex, minutely granulate.

Genitalia: Female, last ventral segment three times as long as preceding; hind border scarcely produced, faintly sinuate, strongly carinate. Male, plates very slender, widened a little toward tip, extended beyond tip of pygofer.

Color: Yellow, tinged with orange; border of front and middle of clypeus, orange or reddish. Pronotum and scutellum blackish, in the female with spots at anterior border of pronotum and borders of scutellum, yellowish; elytra mostly black in the male, but with broad discal stripe and claval nervures, blackish in the female; costa yellowish transparent—this including also most of outer apical areole; wings smoky; veins blackish. Beneath yellowish with black areas on the thorax and coxae; legs yellowish; tarsal claws blackish. In some individuals, especially in the males, there is a dense coppery or bronzy pruinose covering which gives the insect a greenish coppery appearance.

Length, female 8 mm.; male 6 mm.

Seven specimens, two females (type and paratype), four males (allotype and paratype), and one nymph, from Conway Bay, Indefatigable, Galapagos, April 1st, 1923, and James Islan, Galapagos, April 5th, 1923.

The females and males differ considerably in size, but agree closely in marking, except the extent of blackish on the elytra. There is however little question as to their belonging to the same species. The nymph has the vertex elongate, considerably longer than width at base, the borders of the front cinnabar red, extended on basal half of clypeus. The prothorax and mesothorax with large fuscous spots; anterior wing pads mostly fuscous; abdominal seg-

First form on press February 27, 1924

ment greenish yellow with fuscous patches at the sides. Beneath greenish; borders of abdomen tinged with reddish; legs greenish; femora with fuscous patches and a dark annulus near tip. The wing pads extend to base of second abdominal segment which would indicate a third or fourth instar. This species seems most closely related to some of the South American forms, especially *auratus* Fab., but does not agree with any species known to me, and it seems probable that it was derived from a South American source at so remote a period as to have formed a distinct species.

Genus *Philatis* Stål.

Rio Jan. Hmip. p. 68, 1858.

Philatis productus Stål.

Mycterodus productus Stål. *Eugenies Resa, Omkring, Jorden,* p. 278, 1853.

Stål described this species as from "Insulae Galapagenses, Callao, et Panama." Specimens from Tower Island agree very perfectly with his description. The female has the last complete ventral segment deeply indented each side of the middle and emarginate toward the border with the succeeding segment either hidden at the middle or divided by the base of ovipositor. The pygofer is short, compressed, upturned, the sub-anal plate flattened, narrowed posteriorly and bluntly rounded at tip. Male terminal segment twice as long as preceding; hind border concave; lateral angles reaching above base of the plates; plates closely appressed or fused, deeply spoon-shaped, narrowed to blunt tips extending beyond tip of pygofer.

Length 5 mm.

Two specimens, male and female, Tower Island, April 28th, 1923.

Philatis cinerea sp. nov.

Smaller than *productus* and distinctly grayish in color with minute fuscous punctations, a light gray patch on the disk of elytra and a series of whitish cross veins next the claval suture.

Head produced, but not distinctly carinate; margins of vertex slightly elevated; margins of front thin, slightly reflexed. Pronotum short, a little more than half as long as vertex, narrowed at sides; elytra broad, convex; hind border obliquely truncate, nearly right-angled at tip of clavus; wings rudimentary.

Genitalia: Female, last complete segment indented each side near the middle, sinuate at the sides; succeeding segment with sides separated by ovipositor; pygofer short, compressed, scarcely produced upward at tip; sub-anal plate rather long; margins reflexed; tip bluntly rounded. Male, last ventral segment twice as long as the preceding; hind border truncate; plates fused; broadly carinate; tip contracted, blunt, exceeding pygofer.

Color: Dark gray; vertex and front tinged with green; body sprinkled with minute fuscous dots; a broad whitish patch on disk of elytra and a light area

bordering the clavus; outer border between veins distinctly fuscous. Abdomen above smoky, beneath somewhat greenish.

Length, to tip of elytra, female 5 mm.; male 4.5 mm.

Five specimens, three females, two males, Tower Island, April 28th, 1923.

Philatis major sp. nov.

Larger than *productus*, with carina less distinct, and color more uniformly pale testaceous.

Head triangular; vertex depressed, without distinct carina at the middle; borders slightly raised; front without distinct carina; lateral margins thin, slightly expanded. Pronotum about half as long as vertex, angularly emarginate behind; elytral veins conspicuous, reticulate; costa broadly rounded; wings rudimentary.

Genitalia: Female, last complete segment shallowly indented near the middle, deeply sinuate each side; pygofer compressed, curved. Male, last ventral segment equal to preceding, these about three times as long as basal segments; plates narrowed, closely appressed, broadly carinate each side; tips blunt, extended beyond tip of pygofer.

Color: Pale testaceous; veins in the female faintly margined with fuscous; the costal and apical margin minutely dotted with fuscous. Abdomen of male below faintly tinged with greenish.

Length, to tip of elytra, female 6.5 mm.; male 5.5 mm.

Four specimens, two females and two males from Conway Bay, Indefatigable, Galapagos, April 1st, 1923.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

BIRD-INFESTING MALLOPHAGA COLLECTED BY THE WILLIAMS GALAPAGOS EXPEDITION.

BY H. E. EWING.

Bureau of Entomology, United States Department of Agriculture.

(Figure 12).

Our knowledge of the Mallophaga of the Galapagos Islands dates from 1902 when Professor V. L. Kellogg and S. I. Kuwana published their extensive paper (*Proc. Wash. Acad. Sci.*, Vol. vi, pp. 457–499, pls. xxviii–xxxi) on the biting lice collected by the Hopkins Stanford Galapagos Expedition, 1898–1899. The louse specimens were collected by R. E. Snodgrass, at present of the Bureau of Entomology, whose researches on the morphology of the biting lice and several other orders of insects are well known. Snodgrass obtained no less than 43 different species from the islands. Later (1906) Professor Kellogg published another paper (*Trans. Am. Ent. Soc.*, Vol. xxxii, pp. 315–324) dealing with the Mallophaga of these islands and the Revillagigedo Islands. This paper was based on a collection made by Rollo Beck in 1901, which included fifty-four species.

During the summer of 1923, Mr. William Beebe sent to the writer a small collection of bird-infesting Mallophaga obtained by the Williams Galapagos Expedition of the New York Zoological Society during the same year. Although the number of species sent in by Mr. Beebe is small yet the collection is of considerable interest as it contains a record (new species) from the flightless cormorant (*Nannopterum harrisi*).

First form on press February 27, 1924

LIST OF SPECIES, WITH DESCRIPTIONS OF A NEW SPECIES AND A NEW VARIETY.

Family MENOPONIDAE Mjöberg.

Genus *Menopon* Nitzsch.

M. auri-fasciatum Kellogg.

New Mallophaga, Pt. III, *p.* 43, *pl.* iv, *fig.* 5 (1899).

From *Fregata aquila.* Three females and one nymph.

M. navigans Kellogg.

New Mallophaga, Pt. I, *p.* 156, *pl.* xiv, *figs.* 4 *and* 5 (1896).

From *Sula nebouxii,* two females and one male; and from the same host (second lot), four females and one male.

Genus *Colpocephalum* Nitzsch.

C. unciferum Kellogg.

New Mallophaga, Pt. I, *p.* 140, *pl.* xii, *figs.* 1–3 (1896).

From *Pelecanus* sp. Two females.

Family PHILOPTERIDAE Burmeister.

Genus *Philopterus* Nitzsch.

P. breviformis (Kellogg and Kuwana).

Proc. Wash. Acad. Sci., Vol. iv, *p.* 463, *pl.* xxviii, *fig.* 3 (1902).

From *Progne modesta.* One female specimen.

Genus *Esthiopterum* Harrison.

E. helleri (Kellogg and Kuwana).

Proc. Wash. Acad. Sci., Vol. iv, *p.* 479, *pl.* xxx, *fig.* 3 (1902).

From *Sula piscator.* Three male specimens.

E. nannopteri sp. nov.

Fig. 12

Female: Head stout, subtriangular; forehead subconical, sides very slightly concave; postantennal region longer and broader than forehead; temporal lobes large, evenly rounded; posterior margin of head slightly convex. Clypeus broader than long, signature shield-shaped, slightly longer than broad and clearly outlined. Trabeculae minute. Mandibles stout, bifid at tip. Eyes small but with projecting corners and jet black pigment spots. Lateral margins of forehead each with six small setae three of which are situated on clypeal region. Temples each with a very long seta at the posterior angle and three minute prickles on lateral margin. Antennae about half as long as head; second segment longest; last segment tipped with minute setae.

Thorax about as long as head but not as wide. Prothorax fully twice as broad as long and bare above except for a pair of long and a pair of small setae at each of the posterior angles. Meso-metathorax twice as long as prothorax and broader, sides divergent posteriorly; each posterior angle with a tuft of four

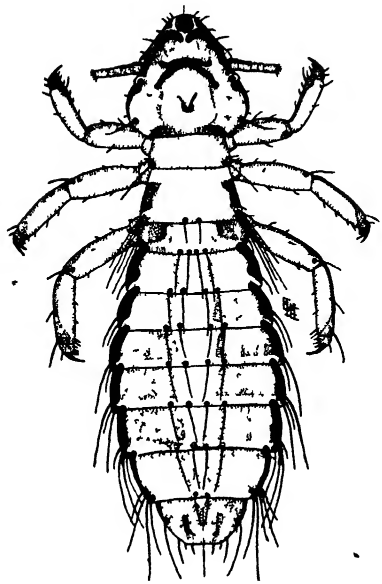


FIG 12—*ESTHIOPTERUM MANNOPTERI* sp nov, female, × 30.

long, unequal setae, some of which are longer than the segment itself. Legs large and conspicuous; the posterior pair, which is slightly the largest, reaches to the middle of abdomen. Claws unequal, those of the second legs are nearly equal. Femora slightly swollen and subequal in length to the tibiae.

Abdomen swollen and broadest at the fourth or fifth segment; pleural bands dark brown, almost black; tergal bands broadly interrupted at the middle and not quite as broad as the segments, brown in color. Above, the abdomen bears four submedian rows of long setae and on the posterior corners of each segment is one or more long setae, the number being greatest on the next to the last segment which bears a tuft of five such setae at each posterior corner. The first segment of the abdomen is the shortest, the second is longer than either I, III or IV, the last is almost as long as broad.

Length, 2.3 mm.; greatest width, 0.8 mm.

Nymphs: Similar in shape to adult, but smaller and paler. Smaller nymphs without abdominal bands. Last nymph with dark brown pleural markings.

Length of last nymph, 2.0 mm.; greatest width, 0.6 mm.

Type host and type locality: From *Nannopterum harrisi*, Galapagos Islands.

Type: Cat. No. 23764, U. S. N. M.

Described from one female and four nymphs. Holotype a female.

This is the first record of an *Esthiopterum* species from the flightless cormorant, and as far as the writer has been able to determine is the only Mallophagan record from this remarkable and rather recently discovered bird. Snodgrass obtained some of these cormorants in the Galapagos but no lice from them.

Beck in his trip to the Galapagos in 1901 took some of these flightless cormorants, two of which are now mounted specimens in the United States National Museum. The Mallophaga which he collected this year were worked up by Professor Kellogg, yet in Kellogg's paper I find no mention of any lice from the flightless cormorant. Also this host is not mentioned in the list of hosts of the Mallophaga known from the birds of the Galapagos Islands published earlier by Kellogg and Kuwana.

The species is distinctive and does not resemble any of those previously listed from the Galapagos. However, it is closely related to *E. farallonii* (Kellogg), described from the Farallone Cormorant, *Phalacrocorax dilophus albociliatus*, taken at Monterey Bay, California. It differs from Kellogg's species in being smaller, having a decidedly wider head, longer setae on the abdomen and much larger legs, and, probably most important of all, in not having the median abdominal blotches. Although of about the same dimensions as *E. acutifrons* (Rudow), taken from *Phalacrocorax sulcirostris*, the specimens from *Nannopterum* differ from Rudow's species decidedly in the shape of the head and in various body dimensions.

E. pelagicum (Denny).

British Anoplura, p. 173, *pl.* xiv, *fig.* 2 (1842)

From a petrel. One male specimen.

E. potens var. **minor**, var. nov.

Similar to the type form taken from *Sula piscator* in the Galapagos and described by Kellogg and Kuwana. It differs from the species described by these authors chiefly in size. Males of var. *minor* are but little over 3 mm. in length, while the length given by Kellogg and Kuwana for *potens* proper is 4 mm. The females also of *minor* are somewhat smaller than those of the type form. Specimens of *minor* are more strongly banded than represented in the drawing of *potens* given in Kellogg's and Kuwana's paper.

Type host and type locality: From *Sula nebouxii* taken in the Galapagos Islands.

Type slide: Cat. No. 23765, U. S. N. M.

Described from a male, two females and a nymph in one lot and from two males, two females and two nymphs of another lot. All specimens from *Sula nebouxii* taken in the Galapagos.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

DIPTERA OF THE WILLIAMS GALAPAGOS EXPEDITION.

BY CHARLES W. JOHNSON.

(Figures 13–14).

This report is concerned with a collection of Diptera made by William Beebe on the Williams Galapagos Expedition. This was sent out under the auspices of the Department of Tropical Research of the New York Zoological Society.

The first Diptera described from the Galapagos Islands were collected by Charles Darwin, while on the memorial cruise of H. M. S. *Beagle* around the world. The specimens were collected from September 15th, to October 20th, 1835, and nine species were described by Francis Walker in his "List of Diptera" in 1849. During the cruise of the Swedish frigate *Eugenies*, the Galapagos were again visited, and the Diptera collected,—numbering twelve species,—were described by C. G. Thomson in 1868. The British S. S. *Petrel* visited the islands in 1875, and among the insects were two Diptera recorded by F. Smith in the "Proceedings of Zoological Society of London for 1877, page 84." During the cruise of the U. S. S. *Albatross* in 1887 and 1888, these islands were again visited, but only one undetermined species of Culex was reported.

In 1898–1899 there was an expedition known as the Hopkins Stanford Galapagos Expedition. Among the insects collected by Mr. R. E. Snodgrass, the entomologist, were thirty-five species of Diptera, that were recorded by D. W. Coquillett.[1] Of these, twenty-four had not previously been reported from the islands and of these ten were described as new. The present paper deals with twenty-eight species, of which thirteen have not been before recorded. Deducting synonyms it makes a total of fifty species of Diptera recorded from the Galapagos Including three undetermined species, the number apparently peculiar to the islands is thirty-eight.

[1] *Proceedings Washington Academy of Sciences*. Vol. III, pp. 371-379, 1901.

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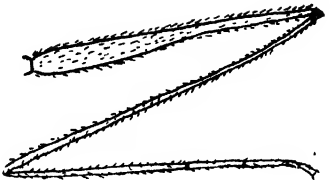

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FIGS. 13–14. *GALAPAGOMYIA LONGIPES* gen. et sp. nov.
Fig. 13. Wing. Fig. 14. Front leg.

Family CHIRONOMIDAE (The Midges).

Chironomus sp.

One imperfect specimen in alcohol, South Seymour, April 22nd.

Ceratopogon galapagensis Coquillett.

C. galapagensis Coquillett, *Proc. Wash. Acad. Sciences*, Vol. III, p. 372, 1901.

Four specimens in alcohol, South Seymour, April 20th.

Tanypus sp.

One imperfect specimen in alcohol, South Seymour, April 22nd.

Galapagomyia longipes gen. et sp. nov.

Male: Head yellowish, *the prominent facial protuberance bearing long black hairs*, the proboscis nearly as long as the face, *palpi large*, yellow with black hairs, antennae yellow, scape about three times the diameter of the first joint of the flagellum, the joints of the latter *six in number*, are *rounded* and each bear three verticilli, the terminal joint, which is about double the length of the preceding joint, tapers to a point. Thorax brown, with three dorsal rows of hairs, pleura yellow, with a large, brown, central spot, scutellum brown. Abdomen with both the dorsal and ventral segments brown, margined posteriorly with yellow, hypopygium comparatively small, in form similar to a *Diamesa*. *Legs long, femora yellow, thickened at the basal half, tibiae brown, the front tibiae about one-fourth longer than the femora*, the others but slightly longer, tarsi brown, *the metatarsi about one-half the length of the tibiae, the other joints of the tarsi together not quite as long as the metatarsi, fourth joint less than one-half the length of the third*, legs covered with fine black hairs, halterers yellow, wings brownish hyaline, the costa, first and second veins hairy. Length, 4 mm.

Female: similar to the male but only 3 mm. in length. Ovipositor short. The eggs show distinctly through the thin distended sides of the abdomen.

Two specimens in alcohol, Seymour Bay, Indefatigable, April 26th. The italicized portions of the above description represent the generic characters.

Family TIPULIDAE (The Crane-flies).

Dicranomyia sp.

One specimen, Conway Bay, Indefatigable, April 1st.

The discal cell is open, the venation resembling that of *D. floridana* O. S. The abdomen is missing and it would be inadvisable to describe it without the male genitalia.

Family CULICIDAE (The Mosquitoes).

Aedes taeniorhynchus portoricensis (Ludlow).

Taeniorhynchus niger Gibs (*non* Theobald) *Jour. Trop. Med.*, Vo . 7, *p.* 382, 1904.
Culex portoricensis Ludlow, *Can. Ent.*, Vol. 37, *p.* 386, 1905.
Aedes (Taeniorhynchus) portoricensis Dyar. *Proc. U. S. Nat. Mus.*, Vol. 62, *p.* 88, 1922.

Two mounted specimens, Conway Bay, Indefatigable, April 1st, and some forty-eight specimens in alcohol, from Seymour Bay, Indefatigable, South Seymour and Tower, April 18th to 28th.

This is undoubtedly what Coquillett recorded from the Galapagos as *Culex taeniorhynchus*. Differs from *taeniorhynchus* only in having the last hind tarsal joint strongly blackish tipped. The habits are the same as those of *taeniorhynchus* of which this is to be considered a local race." (Dyar). The larva were in "salt water tide pool," at Eden, April 2nd.

Family TABANIDAE (The Horseflies).

Tabanus vittiger Thomson.

T. vittiger Thom., *Eugenies Resa*, *p.* 451, 1868.

Four specimens, Conway and Seymour Bays, Indefatigable, April 1st and 22nd.

This species resembles the common *T. lineola* Fabr.

Family BOMBYLIIDAE (The Bee-flies).

Villa primitiva (Walker).

Anthrax primitiva Walker, *List Diptera*, II, 257, 1849.
Anthrax lateralis Thomson, *Eugenies Resa*, *p.* 482, 1868. *non* Say 1823.
Anthrax nudinscula ? Coquillett, *Proc. Wash. Acad. Sciences*, III, 373, 1901. *non* Thomson.

One specimen, Conway Bay, Indefatigable, April 1st.

The description by Walker seems to agree with this species, and as Thomson's name is pre-occupied I have adopted it. Coquillett placed *A. lateralis* Thomson doubtfully as a synonym of *A. nudinscula* Thomson, described from Panama, but the description does not substantiate this.

Villa tincta (Thomson).

Anthrax tincta Thomson, *Eugenies Resa*, *p.* 483, 1868.

One specimen, Seymour Bay, Indefatigable, April 22nd.

The specimen is rubbed, but from the form of the head and color of the wings I can only refer it to this species.

Family ASILIDAE (The Robber-flies).

Ommatius marginellus Fabricius.

One specimen, Conway Bay, Indefatigable, April 1st.

This species was recorded from James by Coquillett. The specimen before me is a female and therefore the determination is somewhat doubtful, as there are species in which the costa of the male is not thickened, as for example, *O. saccas* Walker of Jamaica.

Family DOLICHOPODIDAE (The Long-legged Flies).

Asyndetus versicolor sp. nov.

Male: Face with whitish pubescence, front metallic green, palpi black, antennae black, first joint about twice the length of the second, third joint rounded and partly covered by the second, arista about as long as all of the three joints together, thickened at the base. Thorax and scutellum metallic green, covered with a thin yellowish pollen. Abdomen bronze black, with a strong purplish reflection, the first segment and a wide posterior margin on the other segments greenish, which in certain lights show as whitish pollinose spots on the sides of the second, third and fourth segments. Legs greenish black, the front coxae each bearing a pair of long bristles projecting forward. Halterers yellow, wings hyaline, veins dark brown. Length, 3 mm.

One specimen, South Seymour, April 23rd.

Family PHORIDAE (The Hump-backed Flies).

Aphiochaeta scalaris (Loew).

Phora scalaris Loew *Cent.*, VII, *p.* 100, 1869.

One specimen, Tower, April 23rd.

Described from Cuba, it seems to be a widely distributed tropical species.

Family SYRPHIDAE (The Flower-flies).

Baccha clavata (Fabricius).

Syrphus clavata Fabr., *Ent Syst*, IV, 298, 1775.
Baccha fascialis Thomson, *Eugenies Resa*, *p.* 504, 1868

Two specimens, South Seymour, April 23rd.

A widely distributed tropical and subtropical species.

Family SARCOPHAGIDAE (The Flesh-flies).

Wohlfahrtia inoa (Walker).

Sarcophaga inoa Walker, *List Diptera*, IV, 832, 1849

Three specimens, Conway and Seymour Bays, Indefatigable, April 1st, and 22nd.

This species is readily recognized by its prominent epistoma and pubescent aristae, the abdomen has four rows of uniformly pollinose spots on a permanent black ground, third vein of the wings hairy at the base, almost to the cross vein. This is referable to the genus *Wohlfahrtia*, although there are some authors who would erect a new genus for it without wincing.

Sarcophagula occidua (Fabricius).

Musca occidua Fabr., *Ent. Syst.*, IV, 315, 1794.
Sarcophagula occidua Aldrich, *Sarcophaga and Allies*, 40, 1916.

One specimen, Daphne Major, April 22nd.

A widely distributed tropical species.

Sarcophaga violenta Walker.

S. violenta Walker, *List Diptera*, IV, 826, 1849.

One specimen, South Seymour, April 23rd.

The specimen is a male a little larger (14 mm.) than the measurement

given by Walker, but otherwise agreeing with the description. It was recorded by Coquillett from Albemarle.

Sarcophaga reversa Aldrich.

S. reversa Aldrich, *Sarcophaga and Allies*, 127, 1916.

Two male specimens, South Seymour, April 23rd.

This has a wide distribution and the specimens agree so well with the description and figure of the hypopygium, that there is little doubt that they represent this species.

Sarcophaga obtusifrons Thomson.

S. obtusifrons Thomson, *Eugenies Resa*, 536, 1868

One specimen in alcohol, Seymour Bay, Indefatigable, April 23rd.

Family MUSCIDAE.

Cochliomyia macellaria (Fabricius).

Musca macellaria Fabr., *Syst. Ent.*, p. 776, 1775.
Musca phanda Walker, *List Diptera*, IV, 869, 1849.
Lucilia quadrisignata Thomson, *Eugenies Resa*, p. 544, 1868.
Compsomyia macellaria, E. L. Arribalzaga, *Anales Soc.*, *Cien. Argentina*, X, p. 70, 1880. Williston, *Proc. U. S. Nat. Mus.*, XII, 203, 1889.
Chrysomyia quadrisignata Coq. *Proc. Wash. Acad. Sci.*, III, 375, 1901.
Cochliomyia macellaria Towns. *Jour. Wash. Acad. Sci.*, V, 646, 1915.
Callitroga macellaria Johns, *Bull. Amer. Mus. Nat. Hist.*, XLI, 439. 1919.

One specimen, Conway Bay, Indefatigable, April 1st.

The specimen agrees with the descriptions of both Walker and Thomson and I find no character to separate it from the common and widely distributed "Screw-worm fly" *C. macellaria* Fabr. The synonymy of this species is large, although some of the twenty-six species placed there by Arribalzaga and Williston will ultimately prove to be good species when more thoroughly studied. The *Musca ochricornis* Wied., recorded from the Galapagos by F. Smith, may also represent this and not the Brazilian species, which is placed in the genus *Lucilia*.

Family ORTALIDAE.

Pareuxesta latifasciata Coquillett.

P. latifasciata Coq., *Proc. Wash. Acad. Sciences*, III, 376, 1901.
P. intermedia Coq., *l. c.* p. 377.

Seven males and seven females mounted and thirty-nine in alcohol, Tower, April 28th and 29th. "Hundreds of these flies clustered on gull excrement on the beach."

The color of the last two abdominal segments of the female varies from yellow to black, thus eliminating one of the characters used by Coquillett to separate *P. intermedia* from *P. latifasciata*. The width of the apical band on the wing is also variable, and it is impossible to draw the line between two-thirds as wide as the preceding hyaline interval in one, to one-half to three-fifths as wide in the other. I am therefore making *P. intermedia* a synonym.

The larvae were also collected. They are whitish, cylindrical, tapering anteriorly to a point. The hook-like mouth parts can be seen through the somewhat transparent tegument, the posterior end is truncated with two prominent

anal tubercles, ventral surface with low transverse ridges armed with rows of small chitinous spines. Length, 4 mm.

Pareuxesta obscura Coquillett.

P. obscura Coq., *Proc. Wash. Acad. Sci.*, III, 377, 1901.

Seven specimens, Daphne Major, April 22nd.

All the specimens are males, but the narrow bands of the wings readily separates it from *P. latifasciata*. One specimen has the bands obsolete, suggesting that possibly *P. hyalinata* Coq., with unmarked wings, may represent an extreme variation.

Family CHLOROPIDAE.

Hippelates pusio Loew.

H pusio Loew, *Cent.*, X, 87, 1872.

Eight specimens (four in alcohol). Tower, April 28th, 29th.

"These flies were attracted to small abrasions on our hands or arms." This, and several other species, are often prevalent in the southern States and West Indies and largely instrumental in spreading an infectious disease known as "sore eye" or pink eye, see Scharz, "Hippelates plague." *Insect Life, Vol.* 7, *p.* 137, 1895.

Family DROSOPHILIDAE (The Pomace-flies).

Drosophila willistoni Sturtenant.

D. pallida Williston, *Trans. Ent. Soc. London* 1896, *p* 415 (*non* Zetterstedi 1847).

D. willistoni Sturt., *Ann. Ent. Soc. Amer.*, IX, 327, 1916. *N. Amer. Drosophila, p.* 89, 1921.

One specimen, a female, in alcohol, South Seymour, April 22nd.

This seems to belong to this widely distributed species of tropical America.

Family AGROMYZIDAE.

Odinia williamsi sp. nov.

Male and female: Front, vertex and occiput grayish white, the front and vertex together forming a quadrangle, with three pairs of frontal orbital bristles, the two upper pairs reclinate, the lower pair convergent, the two pairs of vertical bristles reclinate, the lower pairs of ocellar bristles proclinate and the upper pair reclinate, a fine curved line extends from above the base of each antennae, upper half of the face black, the lower part and cheeks silvery white, vibrissae black, curved, with the basal half thickened, proboscis and palpi yellow, antennae with the second joint white above and black below, third joint about one and a half times as long as the second, yellow, with a broad longitudinal black stripe, arista black, base yellow. Thorax grayish with very small black spots at the base of each hair and bristle, one pair of acrostichals and four dorsocentrals, scutellum gray margined with brown and with four marginal bristles, abdomen gray, sparsely covered with black hairs, second, third and fourth segments each with pairs of brown subdorsal and smaller lateral spots. Femora black, tips of the femora and the tibiae and tarsi yellow, the posterior tibiae with a basal and subapical band of brown, halterers yellow, wings grayish,

with some thirty irregular black spots, that are surrounded by a narrow hyaline margin, tegulae white. Length, 3 mm.

Two specimens, South Seymour, April 22nd, 23rd.

This beautiful little fly is dedicated to the promoter of the expedition.

Family HIPPOBOSCIDAE (The Tick-flies).

Olfersia spinifera (Leach).

Feronia spinifera Leach, *Mem. Wernerian Nat. Hist. Soc.*, II, 557, *Tab.* 24, *f.* 1-3, 1817.

Eleven specimens, Tower, April 26th–28th.

Living upon the Frigate-bird (*Fregata aquila*).

Olfersia fossulata Macquart.

O. fossulata Macq., *Dipt. Exot.*, II, *part* 3, *p.* 434, 1843.

One specimen, Daphne Major, April 22nd. From the Brown Pelican, (*Pelecanus fuscus californicus*).

Recorded by Coquillett from Wenman. In the absence of specimens of the true *O. spinifer* I confused this with that species in my paper on the Diptera of the Bahamas (Psyche XV, 80, 1908). The species there recorded from the Cormorant and Booby are really this species, which measures only about 5–6 mm., while *O. spinifer* is from 8-9 mm. in length.

Ornithoponus americanus (Leach).

Feronia americana Leach, *l. c.* 557, *Tab.* 27, *f.* 1-3, 1817.
Ornithoponus americana Aldrich, *Ins. Ins. Menst.* , XI, 77, 1923.

Seven specimens, Seymour Bay, Indefatigable, April 22nd.

From a hawk, *Buteo galapagensis*. The specimens agree with this common and widely distributed species, which has been recorded from three species of *Buteo* and several of the owls.

Ornithoponus intertropicus (Walker).

Ornithomyia intertropica Walker, *List Diptera*, IV, 1144, 1849.
Olfersia intertropica Austen, *Annal, Mag. Nat. Hist.*, *ser.* 7, XII, 264, 1903.

Three specimens, Seymour Bay, Indefatigable, April 22nd.

From a heron, *Butorides sundevalli*. This species is closely allied to *O. albipennis* Say, which frequents the various herons of North America.

The types described in this paper are in the Laboratory of the Department of Tropical Research, New York Zoological Society.

ADDENDA.

In preparing the above paper I did not discover until after I had returned the galley proof that Dr. C. H. T. Townsend had described four new species,—the genotypes of four new genera, from the Galapagos. The descriptions are based on species previously recorded by Coquillett under other names in his report on the Diptera collected by the Hopkins Stanford Galapagos Expedition, but this fact is not stated by Dr. Townsend.

In the Insecutor Inscitiae Menstruus, vol. 5, p. 163, 1917, under the title "New Genera of Amobiinae" he describes *Opsophytopsis insularis*, Albemarle,

Jan. 18, 1899. Under "Genera of the Dipterous tribe Sarcophagini" (Proc. Biol. Soc. Washington, vol. 30, p. 196, 1917), he described *Prosthetocirca cana*, Narborough, Jan. 13–29, 1899, Albemarle, Jan. 1–18, 1899, *Gigantotheca galapagensis*, Albemarle, Jan. 18, 1899, and *Sarothromyiops cinctus*, Culpepper, Dec. 10, 1898. The types are in the U. S. National Museum. The only comment by Dr. Townsend relative to previously described species is,—"I can identify none of the above Galapagos forms with *Sarcophaga inoa* Walker."

It seems likewise difficult from the description to identify Dr. Townsend species. Therefore, a study of his types is just as essential as a study of those of Walker. In referring this complex to Dr. J. M. Aldrich he says:—"It is too bad you have not been enjoying these new genera for the past six years. There are a few good genera among them and I think *Prosthetocirca* is one, as the front rows do not diverge below, which is a pretty good character. Coquillett's specimen with his label *Sarcophaga inoa* was included by Townsend in the material of his *Prosthetocirca cana* but he did not mention that helpful item. I do not believe that Coquillett was correct because Walker's statement about the 'four hoary spots,' on each segment does not seem to agree. Townsend's *Sarothromyiops cinctus* is a synonym of *P. cana* as he could easily have ascertained if he had spread the genitalia. He separates the genera on anterior acrostichals which are in this case not of specific importance. We have several other specimens and one or two show a single acrostichal developed."

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

ARACHNIDA OF THE WILLIAMS GALAPAGOS EXPEDITION.

BY NATHAN BANKS.

(Figures 15–18 incl.).

This expedition of the Department of Tropical Research under the auspices of the New York Zoological Society visited the Galapagos in April, 1923. The collection of Arachnida was made by William Beebe.

The Arachnida taken by the expedition are mostly those previously recorded from the islands. Four species are described as new. There are twenty-four species of spiders, five of mites, and two other Arachnids, thirty-one in all; nine of these are new to the fauna of the islands. Several of the additional species are common in the West Indies or Central America.

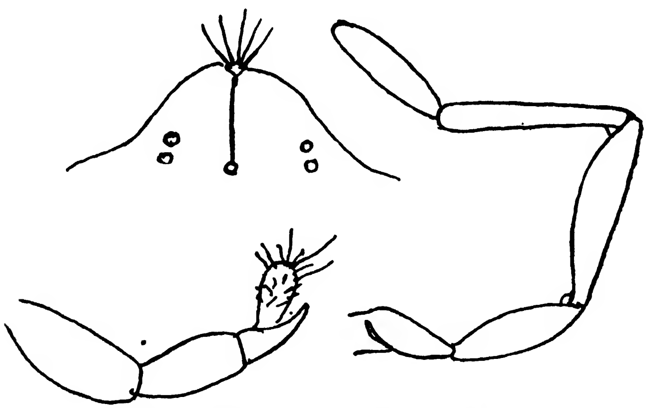

FIG. 15. *ERYTHRAEUS REMOTUS* sp. nov.
Crista, palpus and leg I.

Order ACARINA.

Family ERYTHRAEIDAE.

Erythraeus remotus sp. nov.

(Fig. 15).

Body about one and three-fourths times as long as broad, broadest in front of the third legs, but not much narrowed behind, in front with a broad, rounded lobe. Dorsum clothed with many short, spine-like hairs, some near the eyes

First form on press February 27, 1924

and crista longer. Cephalothorax not marked behind, two eyes each side, about diameter apart; crista short, enlarged at tip, and in front, where there are five long bristles. Legs very slender, front pair longer than the body, hind pair twice as long as body, second and third pairs about as long as body. Tarsus I is about two-thirds as long as the metatarsus, tarsus IV about two-fifths as long as the metatarsus, latter a little longer than the tibia. Palpus rather slender, penultimate joint stout, pointed, last narrowed at base, with several bristles at tip.

Length, 1.7 mm.

Under leaves on beach, Indefatigable, April 19th.

Atomus sp.

One specimen, Tower, April 27th.

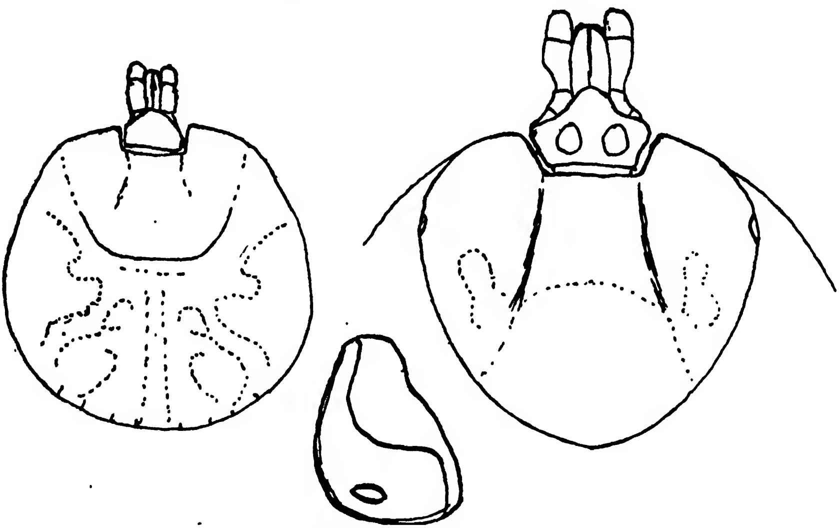

FIG. 16. *AMBLYOMMA WILLIAMSI* sp. nov.
Dorsum of male. Shield and stigmal plate of female.

Family IXODIDAE.

Amblyomma williamsi sp. nov.

(Fig. 16).

Male: red brown; a large pseudoscutum, and two radiate spots each side more yellowish; legs pale yellowish; venter reddish or yellowish. Body about as broad as long, in front rather shouldered, making the front broader than usual; pseudoscutum truncate behind, two raised spots each side and a median streak deeply and heavily punctured, except the median streak; the punctures separate; hind margin with a few hairs. Coxal tubercles very small, hardly noticeable on the hind coxae; hind tarsus tapering, without a spur below. Stigmata more slender than in female, the smooth area a little larger.

Female: red brown, more reddish beneath; legs pale yellowish; scutum with large pale spot on the hind lobe, and extending forward each side on the lateral lobes. Body with many short, stout hairs, not arranged in rows; no long hairs. Scutum rather broader than long, cordate, posterior sides evenly convex, finely, evenly and deeply punctured, the punctures separate; eyes small, hardly convex; porose areas rather large, nearly circular and about diameter apart; coxae with only very small tubercles. Stigmata subtriangular, with a long smooth area in front above, the stigmata proper being cone-shaped.

Length of male, 2.5 mm.; engorged female, 8 mm.; the scutum; 1.6 mm.

From Conolophus lizards, South Seymour, April 20th.

Differs from *darwini* by hairs not arranged in rows, and from *hirtum* by absence of long hairs.

Amblyomma darwini Hirst.

From Amblyrhynchus lizards on South Seymour, April 20th, and Indefatigable, March 28th and from Tropidurus lizards on Eden, April 2nd.

Ornithodoros talaje Guerin.

From Eden Island, April 2nd,; occurs in Central America.

Order SOLPUGIDA.

Ammotrecha solitaria Banks.

Several from Tower, April 27th, and Daphne, April 23rd.

Order SCORPIONIDA.

Hadruroides lunatus Koch.

Specimens from Eden, April 1st; South Seymour, April 20th and 22nd.; and Daphne, April 23rd.

Order ARANEIDA.

Family FILISTATIDAE.

Filistata fasciata Banks.

Immature from Tower, April 28th.

Family SCYTODIDAE.

Scytodes fusca Walck.

One from Indefatigable, April 4th; known from the West Indies.

Scytodes hebraica Simon.

One from Tower, April 28th; known from Central America and West Indies.

Sicaroides ultriformis Butler.

Immature from Eden, April 2nd, under stones.

Family DYSDERIDAE.

Ariadne tarsalis Banks.

One from South Seymour.

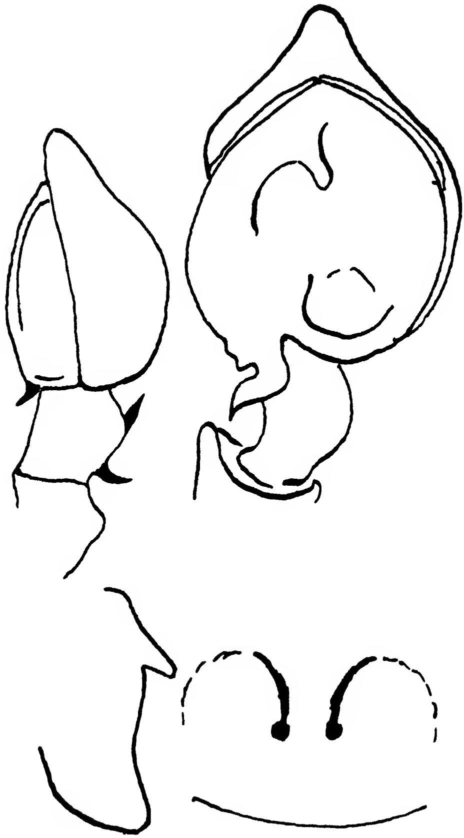

FIG. 17. *DICTYNA REMOTA* sp. nov.
Palpus from side and beneath; side view of mandible of male and epigynum.

Family DRASSIDAE.

Zelotes galapagoensis Banks?

An immature specimen from the beach of Indefatigable, April 19th, agrees with the description, but one cannot be certain without a mature specimen.

Family CLUBIONIDAE.

An immature specimen of a *Clubiona*, or allied genus, is from Tower, April 27th.

Family DICTYNIDAE.

Dictyna remota sp. nov.

(Fig. 17)

Cephalothorax yellow-brown, with white hairs; legs pale, unmarked; abdomen whitish to greyish, with brown basal median stripe and two lateral stripes behind; venter pale. Related to *D. parietalis* of Central America, with which I formerly identified it. It differs in several respects; the female shows no bands on the legs the epigynum shows two smaller dark spots, farther apart, and the dark lines from them run mostly forward. The male has the same shaped mandibles as in *D. parietalis*, with the spine near outer base; the palpi are similar, the patella has a swelling at inner tip, the tibia has a hook at base similar to that of *D. parietalis*, but the subapical process is very different, a slender pointed process, whereas *D. parietalis* has a broad plate.

Length, 1.6 to 2 mm.

Daphne, April 23rd.

Family THERIDIIDAE.

Lathrodectes apicalis Butler.

From South Seymour, April 20th.

Argyrodes jucundus Cambr.

From Albemarle, April 6th.

Family EPEIRIDAE.

Gasteracantha insulana Thorell.

From Albemarle, April 6th.

Argiope argentata Fabr.

From Indefatigable, April 8th, Duncan, April 25th, Tower, April 27th, Daphne, April 23rd, and South Seymour, April 20th.

Epeira oaxensis Keys.

From Indefatigable, April 4th and 8th, Duncan, April 25th, Tower, April 27th and 28th, James, April 4th, Eden and Tagus, April 6th, South Seymour, April 25th.

Epeira labyrinthea Htz.

From Daphne, April 23rd, and Tower, April 27th, 28th and 29th.

Epeira prompta Htz.

From Indefatigable April 4th, and South Seymour, April 20th.

Cyclosa conica Clerck.

From Daphne, April 23rd.

Nephila clavipes Linn.

From Eden, April 6th, common in tropical America.

Family SPARASSIDAE.

Heteropoda venatoria Linn.

One without locality.

Olios galapagoensis Banks.

From Indefatigable, April 8th, Eden, April 6th, and South Seymour, April 20th.

Family CTENIDAE.

Odo insularis Banks.

From Eden, under stones, April 6th.

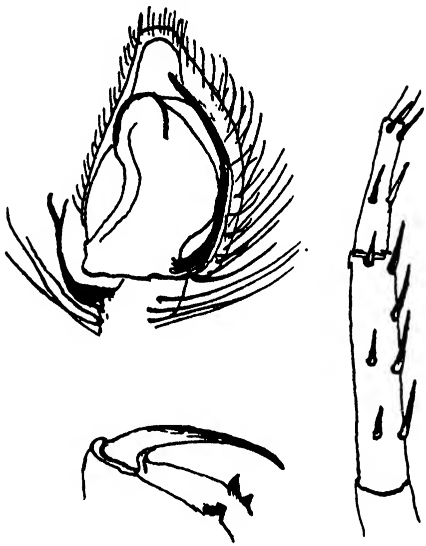

FIG. 18. *PHANIAS DISTANS* sp. nov.
Palpus, tibia and metatarsus I, and fang and grooves of mandible.

Family ATTIDAE.

Plexippus paykulli Aud. et Sav.

Immature from South Seymour, April 20th.

Philaeus pacificus Banks.

From Tower, April 27th.

Metacyrba insularis Banks.

From Daphne, April 23rd.

Phanias distans sp. nov.

(Fig. 18).

Cephalothorax brown, eye area nearly black, mandibles reddish, legs yellowish brown, darker at bases and tips of many joints above; black haired, no fringes,

some short yellow hair on femur I. Abdomen yellow brown, with much black hair, no distinct markings, faint traces of median stripe in a few narrow chevrons; sternum and venter yellow brown with black hairs. Cephalothorax moderately flattened, not much broadened in middle. Abdomen slender, depressed. Each mandible with a bicuspid tooth on inner groove; sternum tapering in front and behind, the coxae I, however, separa e by nearly width of lip; legs slender, femora I and II more swollen, these with two long bristles above near base; tibia I wi h four spines on inner row, three on outer, tibia II with three in each row, metatarsi I and II with two in each row. tibia IV below with one at base and one near tip, metatarsi IV with one at basal third, and a pair at tip below; patellae III and IV unspined. Male palpus has a process from tibia at first stout, then very slender and forked before tip, alongside of bulb is a rather stout style from base to beyond tip.

Length, 9 mm.

From South Seymour.

Evidently belongs to Simon's group of Maevia and Peckham's *Marptusa* group. Differs from *Marptusa* in more separated anterior coxae and rather fewer spines on legs, a though this is doubtless variable.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

THE FORMICIDAE OF THE HARRISON WILLIAMS GALAPAGOS EXPEDITION.

BY WILLIAM MORTON WHEELER.

(Figures 19–27 incl.).

Four years ago I published an account of the Galapagos ants collected by the Expedition of the California Academy of Sciences in 1905 and 1906 and of those previously taken on some of the voyages of the "Albatross."[1] The fact that the description of these materials revealed almost nothing in regard to the habits of the insects and the prospect of finding additional species led me to accept the very generous invitation of Mr. Harrison Williams and Mr. William Beebe to join their expedition to the archipelago. Although the region that could be covered in the time at our disposal was limited, we were able to secure nineteen different forms, eight of which (two species and six varieties) are new to science and one (*Monomorium floricola*) a well-known tropicopolitan ant not hitherto recorded from the islands. The collection of so small a number of forms in any spot on the American mainland, except its arctic and antarctic ends, would have very little or no significance, but considering the meagerness of the Galapagos ant-fauna and the time and effort required in securing even a small number of specimens, those obtained and the observations made on their habits are well worth recording. Many other groups of insects, such as the butterflies, bees, wasps, termites, many families of Diptera, Coleoptera, etc., are even less abundantly represented in the Galapagos fauna. To the general statements on the Formicidae in the introduction to my paper of 1919 I have nothing to add.

Family FORMICIDAE.

Subfamily PONERINAE.

Cylindromyrmex williamsi sp. nov.

(Fig. 19, *b* and *c*).

Worker. Length 4.5–6 mm.

Closely related to *C. striatus* Mayr. Head longer than in that species, oblong, about one and a fourth times as long as broad, with nearly straight, parallel sides and feebly excavated posterior border. Eyes rather large, but

[1] The Ants of the Galapagos Islands, Proc. Calif. Acad. Sci. (4) 2, 1919, pp. 259–310.

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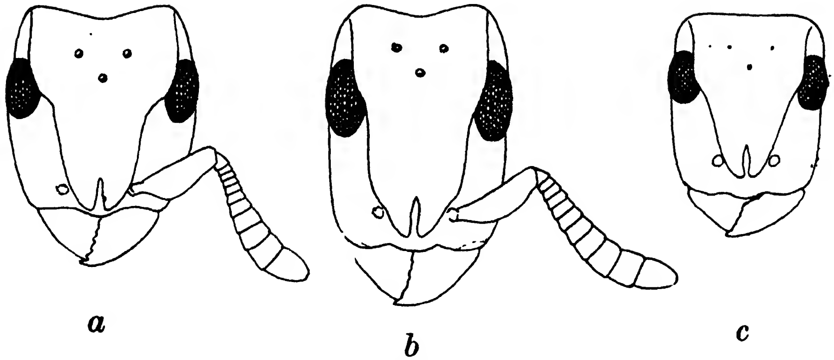

FIG. 19. CYLINDROMYRMEX STRIATUS MAYR; *C. WILLIAMSI* sp. nov. *a*, head of female *C. striatus*; *b*, head of female and *c*, head of worker *C. williamsi*.

not very convex, their anterior orbits at the median transverse diameter of the head. Small workers with distinct ocellar pits, large workers with a small anterior ocellus. Mandibles rather flat, with nearly straight external borders, the apical tooth large and blunt, the apical border somewhat undulating but not distinctly denticulate. Clypeus short, depressed, flat in the middle, more convex on the sides, which are produced and rounded anteriorly while the median border, though broadly rounded, recedes. Frontal area elongate elliptical, deeply impressed. Frontal carinae moderately prominent, extending back to the posterior orbits and thence continuous with rugae to the posterior corners of the head as in *striatus*. Antennal scapes reaching to the eyes, about four times as long as broad; funicular joints 2–6 much broader than long, 7–8 also transverse but proportionally longer, terminal joint about one and one-half times as long as broad. Thorax as in *striatus* but somewhat longer and more rectangular, about twice as long as broad; epinotal declivity sharply marginate laterally and above. Petiole in the smallest worker as broad as long, in larger individuals distinctly longer than broad; its anterior surface marginate on the sides and above, its anteroventral surface with a large, blunt, compressed tooth. Postpetiole from above trapezoidal, one and one-third times as long as its anterior border, the sides much less convex than in *striatus*. First gastric segment about one-fourth broader than the postpetiole; pygidium subtruncate, with a row of acute denticles on each side of its posterior half. Legs very distinctly more slender than in *striatus*, the anterior tibia fully three times as long as broad (in *striatus* scarcely two and one-half times). Middle and hind tibiae each with a single pectinated spur.

Shining; mandibles subopaque, sharply longitudinally striate. Middle of clypeus smooth, its sides, the scapes and the large antennal foveae finely longitudinally striate; cheeks and gular surface of head coarsely and somewhat irregularly, longitudinally striate; head above, thorax, petiole and postpetiole sculptured much as in *striatus*, with coarse longitudinal striae separated by rounded rugae, those on the thorax, petiole and postpetiole very regular, on the

head somewhat divergent posteriorly and dividing, thus increasing their number at the occipital border. There are also some coarse interrugal punctures in this region. The number of rugae on the vertex between the posterior continuations of the frontal carinae is about 15, there are about 10 on the thoracic dorsum and petiole and about twice that number on the postpetiole. Epinotal declivity and anterior surface of petiole shining and very finely shagreened. Gaster and legs very smooth and shining, with minute, scattered, piligerous punctures.

Hairs whitish, very sparse, conspicuous only on the clypeus, tip of gaster and venter; gaster with sparse, rather long pubescence; hairs on the tibiae very sparse, subappressed.

Black; tip of last funicular joint and terminal tarsal joints testaceous.

Female (deälated). Length nearly 7 mm.

Differing from the worker in having the head fully one and one-half times as long as broad. The eyes are larger and there are three rather small ocelli. Thorax somewhat depressed above, the pronotum with concave sides, broader behind than in front and broader than long, its lateral borders straight. Mesonotum and scutellum small, the former as broad as long, arcuately rounded in front. Epinotum with subequal base and declivity, the former of nearly the same shape and size as the pronotum. Sculpture and color similar to that of the worker but the striae on the sides of the thorax are finer. Hairs on the femora and tibiae much more numerous.

This species, which I dedicate to Mr. Harrison Williams, is described from two workers and a female taken near the south end of South Seymour Island, April 20th, 1923. In my paper of 1919 I erroneously identified this ant from specimens taken by Dr. F. X. Williams at Academy Bay, Indefatigable Island, as Mayr's *C. striatus*. On comparing one of the workers collected by Dr. Williams and the three specimens described above with a female of the true *striatus* (fig. 19 *a*) taken by Prof. C. T. Brues at Guayaquill, Ecuador and Cameron's figure of the worker, which he erroneously described as *Holcoponera whymperi*, I find that the Galapagos species is quite distinct. The legs of *striatus* are shorter, much more robust and of a different color, the head is shorter, the eyes smaller and less convex and the median portion of the clypeus longer and more produced, the antennal scapes are broader, the rugae on the head, thoracic dorsum, petiole and postpetiole are somewhat stronger and more even, the pubescence on the gaster is shorter and the hairs on the legs much less numerous. The striae on the mandibles, on the contrary, are more superficial and the mandibles, clypeus, cheeks and antennae are dark red.

The three specimens which I took on South Seymour Island, together with several young larvae, formed the entire personnel of a colony which was nesting in the dead branch of a Celastraceous shrub (*Maytenus obovata* Hook. *fil.*) growing near the beach. Many of the dead branches of the same shrub contained flourishing colonies of *Calotermes pacificus* Banks; but the ants did not actually live among them though evidently occupying galleries which they had once inhabited. This fact is of interest, because colonies of the allied genus Simopone of the Ethiopian and Malagasy regions have been taken in dead branches. Arnold records *S. marleyi* Arnold as occurring in hollow stems of the castor oil plant at Durban, Natal. That the ants of the two genera, Simopone of the Old, and Cylindromyrmex of the New World, which together

constitute Emery's Ponerine tribe Cylindromyrmicini, prey on termites and tend to establish their colonies near these insects is also indicated by Mayr's statement that Hetschko found *C. brasiliensis* in wood in the galleries of a termite at Santa Catharina, Brazil.

The larvae of *C. williamsi*, to which I have referred, were unfortunately lost through breaking of the vial in which they were contained so that I am unable to figure them. They were very long and slender, with narrow, curved neck and small head. The body was smooth, i. e., nontuberculate and covered with numerous, short, even hairs, as in Stigmatomma and allied Ponerine genera.

Among the specimens in my collection I find a winged female of a peculiar Bolivian Cylindromyrmex, of which I insert a description:

Cylindromyrmex (Metacylindromyrmex) boliviae sp. nov.

(Fig. 20).

Female. Length 10 mm.

Closely related to *C. godmani* Forel. Head subrectangular, fully one and one-half times as long as broad, as broad in front as behind but somewhat narrowed in the middle; its posterior border rather deeply and subangularly excised. Eyes moderately convex, but not as large as in the preceding species, their anterior orbits at the median transverse diameter of the head. Mandibles large, convex, with rounded external borders, a blunt apical tooth and broad, toothless apical border. Clypeus very short, abrupt in the middle, overarched by the very large and projecting frontal carinae, which extend back to the middle of the eyes. Frontal area elongate-elliptical, deeply impressed. Antennal scapes about two and one-half times as long as broad, abruptly narrowed at the base, with straight posterior and convex anterior border as in the preceding species; funicular joints 2–6 extremely short and transverse, the two penultimate joints nearly as long as broad. Thorax depressed above; pronotum transversely suboblong, only slightly broader behind than in front, its sides concave, its lateral borders subparallel and marginate; mesonotum as broad as long, its anterior border semicircular, its lateral borders concave; base of epinotum longer than the abrupt declivity which is concave in the middle and submarginate on the sides and above. Petiole subcylindrical, about one and one-fourth times as long as broad, concave on the sides, its anterior surface submarginate on the sides and above, its anteroventral surface with a large, blunt, compressed tooth. Postpetiole as long as broad, somewhat broader behind than in front, with straight sides, anterior and posterior borders, its ventral portion very convex and projecting in front. Pygidium slightly truncated behind, armed with a row of acute denticles on each side of its posterior half. Legs stout as in *C. striatus*, the fore tibiae somewhat less than two and one-half times as long as broad. Median and hind tibiae each with two well-developed pectinated spurs.

Shining; mandibles with fine, interrupted, superficial striae; anterior half of gula with coarse longitudinal striae, posterior half coarsely and sparsely punctate. Cheeks with a long, pronounced longitudinal stria or groove. Antennal foveae rather coarsely striate, remainder of head with longitudinal striae separated by rugae which on the front and occiput become coarser, more regular and very slightly divergent. Scapes very finely striolate. Pronotum with about

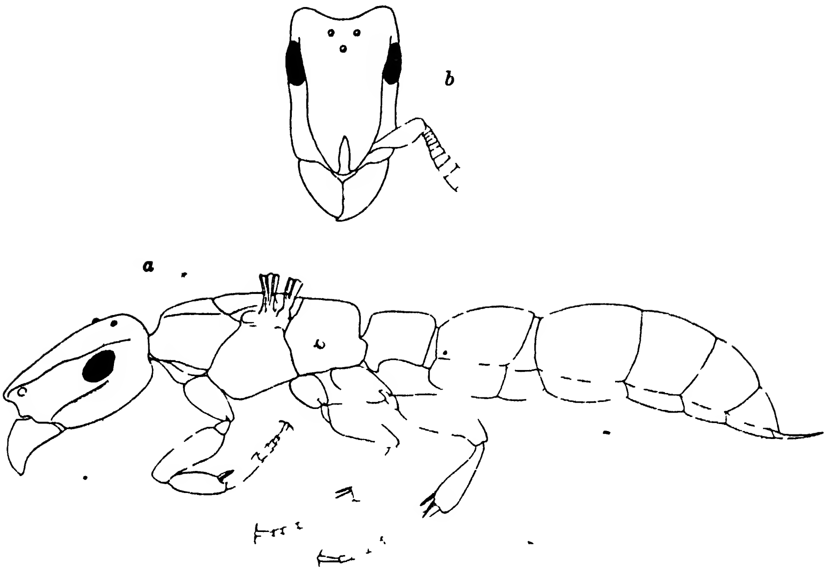

FIG. 20 *CYLINDROMYRMEX (METACYLINDROMYRMEX) BOLIVIAE* sp. nov. Female *a*, profile, wings removed; *b*, head.

20 strong longitudinal rugae, separated by deep striae, mesonotum smooth behind, longitudinally striate in front, the striae diverging posteriorly. Scutellum smooth and shining, with a few punctures near its posterior border. Epinotum and petiole longitudinally striate, the striae rather irregular or branching. Sides of epinotum and lower mesosterna rather finely and sharply striate, upper mesosterna and sides of pronotum very smooth and shining. Postpetiole like the gaster, very smooth and shining, with small, scattered, piligerous punctures.

Hairs yellow, short, erect or suberect, more numerous than in *williamsi* on the head, thorax and petiole, on the gaster less numerous, longer and more erect. Tibiae and tarsi with long, uneven, suberect, somewhat bristly hairs.

Black; mandibles, funiculi, tips and bases of scapes, coxae and tip of gaster deep castaneous red; legs brownish yellow, knees and tips of tibiae darker. Wings distinctly infuscated, with dark brown veins and pterostigma.

A single specimen from Mapiri, Bolivia (Staudinger).

This species is very closely related to *C. godmani* of Panama and Ecuador, also known only from female specimens, but the latter species is larger (12.5 mm.), its antennal scapes and tibiae are shorter (scarcely twice as long as broad), the apical borders of the mandibles are bluntly denticulate, the petiole is shorter and has traces of striae, the femora are darker and the wings are described as brownish violaceous as in the bee *Xylocopa violacea*.

The workers and females of the seven known species of Cylindromyrmex may be separated by means of the following table:

1. Workers 2
   Females 6
2. Eyes very small and flat; anterior border of petiole emarginate in middle; first gastric segment striate 3
   Eyes large and convex, anterior border of petiole entire; first gastric segment smooth and shining 4
3. Head nearly twice as long as broad; apical borders of mandibles edendulate. Length 8 mm. (Brazil) *longiceps* Ern. André.
   Head one and one-half times as long as broad; apical borders of mandibles bluntly denticulate. Length 5.5–6.5 mm. (Venezuela) *meinerti* Forel.
4. Striae of head, thorax and pedicel coarse and regular; coxae trochanters and femora black or dark brown 5
   Striae of head, thorax and pedicel finer and less regular; legs yellow throughout. Length 6–7.3 mm (Brazil, Paraguay) *brasiliensis* Emery.
5. Legs slender, entirely black, except the terminal tarsal joints. Length 4.5–6 mm. (Galapagos Islands) *williamsi* sp. nov.
   Legs stouter, tibiae except their ends, pale ivory yellow (Surinam, Peru, Ecuador) *striatus* Mayr.
6. Frontal carinae moderately large; head not narrowed at the median transverse diameter; postpetiole coarsely longitudinally striate, middle and hind tibiae each with a single well-developed pectinated spur 7
   Frontal carinae larger and more projecting; head appreciably narrowed at the median transverse diameter; middle and hind tibiae each with two well-developed pectinated spurs 8
7. Head one and one-half times as long as broad; legs black, except the terminal tarsal joints. Legs slender. Length 7 mm. *williamsi* sp. nov.
   Head shorter; legs stouter; tibiae, except their tips, pale ivory yellow. Length 7 mm. *striatus* Mayr.
8. Postpetiole nonstriate; fore tibiae more than twice as long as broad; femora yellow; wings brownish. Length 10 mm. (Bolivia) *boliviae* sp. nov.
   Postpetiole somewhat striate; tibiae scarcely twice as long as broad; femora reddish black; wings brownish violaceous. Length 12.5 mm. (Panama, Ecuador) *godmani* Forel.

The foregoing table shows that the species of Cylindromyrmex may be arranged in three distinct groups or subgenera, namely, *longiceps* and *meinerti*, which have very small, flat eyes in the worker and for which I suggest the name **Hypocylindromyrmex** subgen. nov., with *longiceps* as the type; *striatus*, *brasiliensis* and *williamsi*, which have large, rather convex eyes, moderate frontal carinae and only a single well-developed pectinated spur on the posterior tibiae (*Cylindromyrmex* sens. str., with *striatus* as the type), and *godmani* and *boliviae* with large, rather convex eyes, very large frontal carinae and two well-developed pectinated spurs on the posterior tibiae (**Metacylindromyrmex** subgen. nov., with *godmani* as the type). The brownish color and minute eyes of the

two species of Hypocylindromyrmex indicate that they do not inhabit twigs like the species of the two other subgenera but that they lead a hypogaeic life, probably in the abandoned galleries of terrestrial termites.

Ponera beebei sp. nov.

(Fig. 21).

Female (dealated). Length nearly 2 mm.

Head subrectangular, about one-sixth longer than broad, with distinctly concave posterior border, the sides behind the eyes straight and parallel, contracted somewhat in front of the eyes, which are small, rather flat and scarcely longer than their distance from the anterior corners of the clypeus. Ocelli small and widely separated. Mandibles moderately large, their broad apical

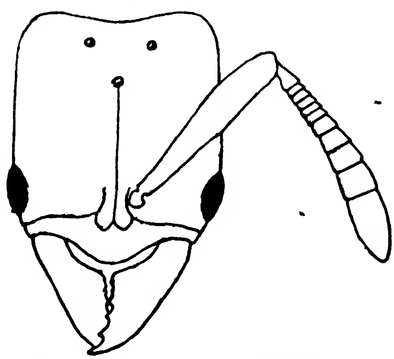

FIG. 21. *PONERA BEEBEI* sp. nov.
Head of female.

borders with four rather widely separated, acute teeth. Clypeus short, abrupt, strongly carinate, its anterior border advanced and rounded in the middle, sinuate on each side. Frontal carinae rounded, with ciliated borders; frontal groove distinct, extending to the anterior ocellus. Antennal scapes not reaching the posterior border of the head; funicular joints 2–6 subequal, very transverse, more than twice as broad as long; remaining joints forming a 5-jointed club, all the joints of which, except the last, are broader than long and gradually increase in length apically, the terminal joint somewhat shorter than the three preceding joints together. Thorax slightly more than twice as long as broad, as broad behind as in front, rounded anteriorly and posteriorly, its dorsal outline straight in profile, the mesonotum and scutellum small and flat, the former broader than long, with semicircular anterior border; epinotum with straight base and declivity, the latter longer than the former, its sides rounded, not marginate. Petiolar node thick, about one and one-half times as high as long, much narrower than the epinotum, truncated anteriorly and posteriorly and with a rounded summit, which is distinctly thinner than the base. Seen from behind the node is subcircular. The ventral surface in profile is feebly convex, not swollen, and without an anterior tooth. Postpetiole trapezoidal from above, broader than long, narrowed in front, with straight anterior and

lateral borders; strongly truncated in front. Constriction behind the postpetiole well-developed. First gastric segment distinctly broader than long, from above transversely rectangular. Legs rather slender.

Shining; mandibles smooth, with minute scattered piligerous punctures; remainder of body finely and distinctly but not very densely nor deeply punctulate; sides of thorax finely rugulose; antennal scapes and legs more finely and densely punctulate and less shining.

Hairs and pubescence white, abundant, the former short and uneven, most distinct on the clypeus, summit of petiole and tip of gaster, the pubescence long, subappressed, grading into the pilosity, conspicuous on the thorax, petiole and gaster, somewhat shorter on the head, especially on its dorsal surface. Antennae and legs with fine, dense, subappressed pubescence.

Dark brown, almost black, mandibles and legs brownish yellow, or testaceous; clypeus, antennae and a large round spot on the front brownish red.

A single specimen which I found under a large stone embedded in the sand of the small beach of Tower Island.

I have described this form as new because I am unable to refer it to any of the species known to me from specimens or descriptions. The antennae seem to be most like those of *P. gleadowi* Forel of India and Borneo, but the color, sculpture, shape of petiole, etc., are very different.

Subfamily MYRMICINAE.

Pheidole williamsi Wheeler var. **seymourensis** var. nov.

Soldier and Worker. Differing from the typical *williamsi* of Indefatigable Island in color, the body being yellowish brown, with the posterior portion of the head, the dorsal surface of the thorax and nodes darker, the gaster almost castaneous brown, and the middle portions of the femora slightly infuscated.

Two very small colonies of this variety were found, one in a nest in the sand just beyond the beach on South Seymour Island, the other under a large stone in the bottom of the crater of Daphne Island. *Ph. williamsi* seems to be closely related to the tropicopolitan *Ph. megacephala* Fabr., but is smaller, the soldier has a smaller, more rounded head, with longer antennal scapes and there are differences in the structure of the thorax and pedicel, the humeri being less prominent and more rounded and the postpetiole shorter and more transversely elliptical.

Monomorium floricola Jerdon.

Several colonies of this minute tropicopolitan ant, hitherto unrecorded from the Galapagos Islands, were found nesting in dead twigs of *Bursera graveolens* Trian. and Planch. in the thickets on Tower Island. The workers were assiduously visiting the nectaries of the flowers of *Cordia lutea* Lam. and of the large cactus, *Opuntia helleri*, which is peculiar to the island. This ant must have reached Tower Island in floating vegetation since the females are wingless.

Solenopsis globularia F. Smith subsp. *pacifica* Wheeler.

(Fig. 22).

Female (deälated), undescribed. Length nearly 4 mm.

Resembling the worker. Head proportionally shorter and more rectangular; eyes much larger. Thorax from above elongate elliptical, narrower than the

head, about two and one-half times as long as broad; epinotum in profile rounded and steeply sloping, without distinct base and declivity; petiole higher and more compressed anteroposteriorly than in the worker; postpetiole short, transverse, about two and one-half times as broad as long. Gaster large and elongate. Sculpture, pilosity and color as in the worker, but each of the gastric segments with a broad, poorly defined, brown transverse band.

Numerous workers and a single female from several colonies found at Seymour Bay, Indefatigable Island, Daphne Island and Tower Island. On Daphne

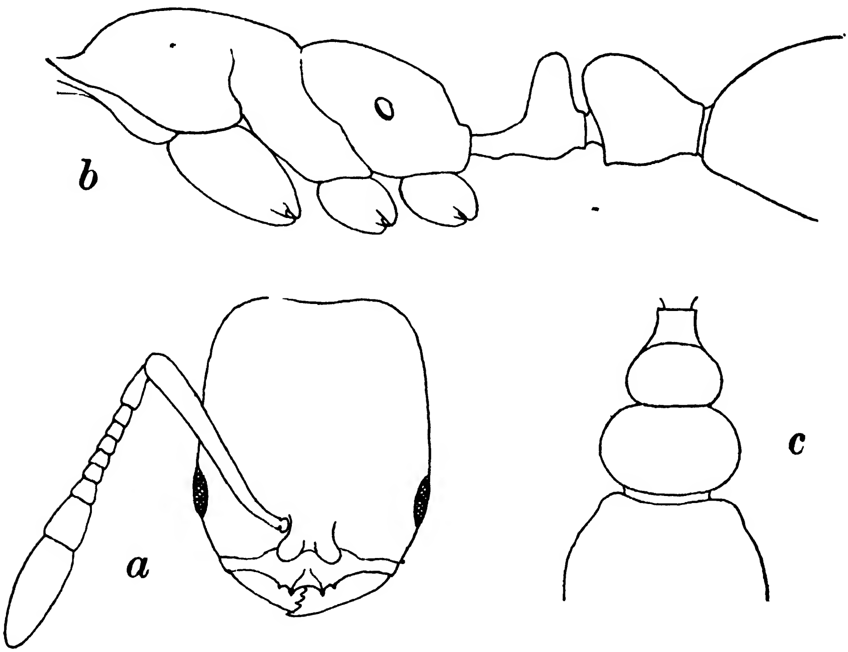

FIG. 22. *SOLENOPSIS GLOBULARIA* F. Smith subsp. *PACIFICA* Wheeler. *a*, head of worker; *b*, thorax and pedicel of same in profile; *c*, pedicel, dorsal view.

Island these ants were nesting under stones at the bottom of the crater, in the other localities under small logs lying on the sandy beach or among the thickets above high water mark. This subspecies was first taken on Albemarle and Tower Islands by F. X. Williams and the Albatross Expedition of 1899.

Tetramorium guineense Fabr.

In my previous paper I recorded this widely distributed tropicopolitan ant from South Albemarle (F. X. Williams). Emery mentioned it from Chatham Island (G. Baur) and the Albatross Expedition of 1899 secured it from the islands but failed to note the precise locality. I found it only on Tower Island, confined

to the small beach and nesting under stones and the bark of bushes. The workers were exploring the foliage of the bushes on which great numbers of frigate birds and gannets were nesting.

Subfamily DOLICHODERINAE.

Dorymyrmex (Conomyrma) pyramicus Roger subsp. *albemarlensis* Wheeler.
(Fig. 23).

This ant, previously known only from Albermarle Island, is common at Seymour Bay, Indefatigable Island and on South Seymour Island. It was

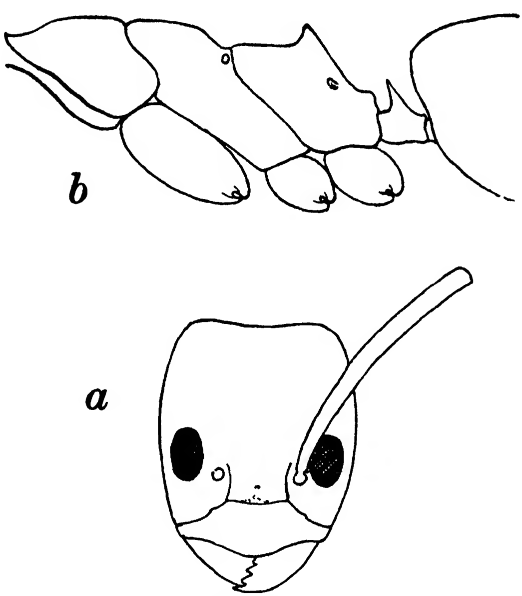

FIG. 23. *DORYMYRMEX (CONOMYRMA) PYRAMICUS* Roger subsp. *ALBEMARLENSIS* Wheeler.
a, head of worker; *b*, thorax and petiole of same in profile.

also taken by members of the expedition at Tagus Cove, Albermarle and on Eden Rock. It nests near sea-level in flat, crater nests in the sandy soil, or decomposed lava in the hot open spaces among the vegetation. The behavior of the very active and enterprising workers is like that of other forms of *pyramicus* which ranges from our Southern and Southwestern States to Argentina.

Tapinoma melanocephalum Fabr.

A widely distributed tropicopolitan ant, the "hormiga bottegaria" of the Latin Americans, previously taken on the east side of Indefatigable Island by Dr. F. X. Williams and on the boat at Chatham Island by Dr. G. Baur. I found several populous colonies on Tower Island, nesting in abandoned Calotermes galleries in dead branches of *Bursera graveolens*.

Subfamily FORMICINAE.

Prenolepis (**Nylanderia**) **vividula** Nyl. subsp. **guatemalensis** Forel var. **edenensis** var. nov.

Eight workers and a deälated female taken by members of the expedition from a single colony on Eden Rock agree closely with the var. *cocoënsis* Forel from Cocos Island, except in color, the gaster being dark brown, in the eyes of the worker which are smaller and more convex than in Forel's variety and the pubescence which, especially on the head and gaster, is distinctly longer, so that these regions are less shining.

Prenolepis (*Nylanderia*) *fulva* Mayr subsp. *nesiotis* Wheeler.

A number of workers taken from a single colony nesting in the sand above high water mark at Seymour Bay, Indefatigable Island agree closely with the cotypes of *nesiotis* from James Island in my collection, except in the coloration of the gaster, which is somewhat darker. The differences do not seem to be sufficient to justify the introduction of a new varietal name.

Genus *Camponotus* Mayr.

Perhaps no other group shows the poverty of the ant-fauna of the Galapagos so clearly as the genus Camponotus, which is represented by such an enormous number of forms in continental tropical America. Only three small species have been recorded from the archipelago: *senex, macilentus* and *planus*, all by Frederick Smith. He recorded the first as having been taken by W. E. Cookson, commander of the *Petrel* while on its voyage to the islands in 1875. As this species has since been taken only in Central and South America and as Smith was notoriously careless in making identifications even of species which he had himself described, I believe that we are justified in dropping it from the Galapagos faunal list. In British Guiana during the summer of 1920 and again in Panama during the summer of 1923 I had an opportunity to study *C. senex*. As Forel was the first to ascertain,[2] this ant, like Oecophylla and many species of Polyrhachis in the Old World and *C. formiciformis* Forel in Central America[3] makes a peculiar nest by using its larvae for spinning leaves together with layers of silk in the form of a ball. The nest may vary from the size of an orange to that of a football and is firmly attached to the twigs of a tree, sometimes at a considerable distance from the ground. Several nests may occur on a

[2] Biol. Centr. Amer. Formicidae, 1899–1900, p. 139, pl. 2, fig. 5.

[3] According to observations recorded in my paper "On the Presence and Absence of Cocoons among Ants, the Nest Spinning Habits of the Larvae, etc. Ann. Ent. Soc. Amer. 8, 1915, p. 323–342, fig. 1.

single tree and may, perhaps, belong to a single polycladic colony. So far as I have been able to observe, *senex* lives only in the low jungle and almost always on trees or bushes growing along water-courses. This is certainly not an environment to be encountered in the Galapagos Islands.

There remain therefore only two species of Camponotus, *macilentus* and *planus*, as occurring on the archipelago. They have been taken on nearly all the larger and on several of the smaller islands and are, in fact, the most abundant and therefore the dominant components of the ant-fauna in the low xerothermal zone, the only part of the islands which has been carefully investigated. Both are very timid species which rarely attempt to bite even when their nests are violently disturbed. Although they coexist in the same localities, their habits are so different that they do not encroach on each other's activities. The pale yellow *C. macilentus* is a nocturnal ant, which lives in rather small colonies in dead branches of trees and shrubs (*Bursera graveolens* and *Maytenus obovata*) that have been hollowed out by Calotermes and wood-boring beetles. The workers and soldiers were never seen abroad in the day-time. At the time of my visit to the islands in the latter part of April, the nests contained considerable brood and many males and winged females. These phases were also taken in August by Dr. F. X. Williams, so that there must be either two brief periods or, more probably, a single protracted period during which the sexual forms are produced. The black *C. planus*, on the other hand, is a strictly diurnal ant which forms much more populous communities and nests in the soil about the roots of trees, shrubs, the large arborescent Opuntias or in old logs. The entrances are small and concealed so that the nests are found only by accident or by following foraging workers. The latter are most frequently seen on the foliage of the thickets in search of insect prey or visiting the flowers for their nectar. The beautiful clustered yellow flowers of *Cordia lutea* attract them as well as many other insects, *Xylocopa*, *Chrysopa*, beetles, etc., in considerable numbers. On Indefatigable and South Seymour I failed to find any males or winged females in the nests during late April, but these phases were secured by members of the expedition April 1 to 7 on Chatham, Albemarle, James and at Conway Bay, Indefatigable Island. Dr. Williams collected males and winged females on Duncan, Charles and Indefatigable during August, October and November. It would seem, therefore, that

this species either sends off its sexual phases at very different times of the year on different islands or that they are developed continuously over a long period from August to the beginning of April.

I maintained in my former paper that both *macilentus* and *planus* have produced a number of varieties, one or more of which occur on each of the islands of the archipelago. The materials collected by the Harrison Williams expedition confirm this statement and fill some of the gaps in the previously known distribution of the species. No forms of *macilentus* were previously recorded from Indefatigable, but the expedition took a new dark variety and a paler undescribed form on that island and South Seymour. A hitherto unnamed variety was also secured on Tower Island. Previous expeditions took no forms of *planus* on James, but members of our party captured specimens of a new variety on that island and also the hitherto unknown male and female of the var. *peregrinus* Emery on Chatham. The two species of Camponotus are so variable and the differences between their varieties often so feeble and illusive that much more material will have to be studied before a satisfactory conspectus of their characteristics and distribution can be given. Future collectors in the islands should therefore make a strenuous effort to obtain as many specimens as possible of these ants.

In my former paper I placed *C. macilentus* in the subgenus Myrmamblys but Emery has recently removed it to his subgenus Pseudocolobopsis[4] and I have followed him in this paper. He agrees with me in placing *planus* in the subgenus Myrmorhachis Forel, but I have recently given the American species of this group the name Myrmocladoecus[5] and this name will have to be substituted for Myrmorhachis (Emery 1920). But all the known neotropical species of Myrmocladoecus (*bidens* Mayr, *bispinosus* Mayr, *latangulus* Rog., *mucronatus* Emery, *quadrilaterus* Mayr, etc.) nest in plant cavities, whereas *planus* nests in the ground. The structure of the head and thorax, the pilosity and sculpture would justify one in placing it in Orthonotomyrmex Ahsmead, were it not that this subgenus is now restricted to Old World species. The precise position of *planus* must therefore be left to be determined by the future student who can make a detailed study of the various sub-

[4] Le Genre "Camponotus" Mayr. Nouvel Essai de la Subdivision en Sousgenres. Rev. Zool. Afr. 8, 1920, p. 229–260.

[5] Professor Emery's Subgenera of the Genus Camponotus Mayr. Psyche 28, 1921, p. 19.

genera of Camponotus and of their limits. For the present I retain the species from the Galapagos in the subgenus Myrmocladoecus.

Camponotus (Pseudocolobopsis) macilentus F. Smith var. **sapphirinus** var. nov.

(Fig. 24).

Worker major. Length 6–7 mm.

Head about one-fifth longer than broad, distinctly broader behind than in front, with nearly straight sides and posterior border; anterior borders of cheeks not very convex nor projecting. Clypeus subrectangular, scarcely broader in front than behind, somewhat longer than broad, its posterior half distinctly

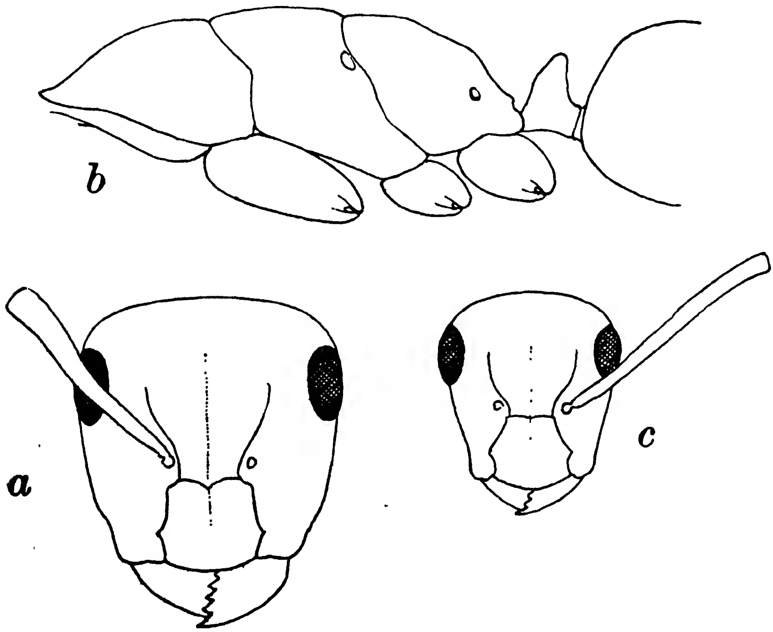

FIG. 24. *CAMPONOTUS (PSEUDOCOLOBOPSIS) MACILENTUS* F. Smith var. *SAPPHIRINUS* var. nov.

a, head of worker major; *b*, thorax and petiole of same in profile; *c*, head of worker minor.

carinate in the middle, its anterior border very feebly and broadly rounded, rather receding. Scapes reaching nearly twice the width of their tips beyond the posterior corners of the head. Thorax strongly compressed behind, the epinotum in profile not evenly rounded but made up of three subequal planes meeting at rounded obtuse angles. Petiolar node low and thick, its upper border blunt, entire and when seen from behind broadly rounded.

Shining; mandibles and anterior portion of head less so than the remainder of the body, which is very finely shagreened.

Pilosity much as in the other varieties, the color considerably darker. Body

brownish yellow; mandibles and anterior border of head brownish red; antennae, a large spot on the front and vertex, the whole meso- and epinotum, the tibiae, tarsi and a broad transverse band on each gastric segment, brown; the cephalic spot, apical half of the scapes and gastric bands darker, more castaneous brown. Owing to its fine transverse shagreening the upper surface of the gaster in direct sunlight has a pronounced blue iridescence, which is absent or very faint in the other varieties. The top of the head and sides of the thorax display a similar but feebler iridescence.

Worker minor. Length 4.5–5.5 mm.

Closely resembling the major worker, except in the shape of the head, which in the minima is nearly one and one-third times as long as broad, with more rounded posterior corners. straight, anteriorly somewhat converging cheeks and broader and less distinctly carinate clypeus, The scapes extend about one-third their length beyond the posterior corners of the head. Color similar to that of the worker major, but there are differences in the head, which is whitish or ivory yellow in front and diffusely brownish behind; the mandibles are brownish yellow, the antennae, especially the apical halves of their scapes, paler than in the major. The pronotum may be somewhat brownish posteriorly, but this is also the case in some of the larger workers.

Female (dealated). Length 7–8 mm.

Like the major worker, but with larger eyes, shorter clypeus and the anterior portion of the head more sharply sculptured. Petiolar node very thick and broad, its superior border entire, very blunt, straight and transverse. The pilosity and color are also similar but in some specimens the dark brown area on the front and vertex is more extensive and less sharply defined, in others restricted to the ocellar triangle. Each ocellus has a black spot at its inner border. Mesonotum with a large rectangular brown spot on the middle of its posterior three-fourths in some specimens, in others there is merely a brownish cloud.

Male. Length 5–5.5 mm.

Pale ivory yellow, head and gaster brownish, the latter with the posterior borders of the segments yellow; the former with the ocellar triangle dark brown, almost blackish, and each ocellus with a black spot at its inner border; the front pale brown but somewhat variable in different specimens. Wings pale yellowish hyaline, the pterostigma scarcely darker than the veins, which are pale yellow. There is a small black spot at the base of each of the anterior wings.

Described from numerous specimens nesting in hollow twigs of *Maytenus obovata*, previously inhabited by *Calotermes pacificus* colonies, near sea-level at Seymour Bay, Indefatigable Island and on South Seymour Island.

This variety of *macilentus* differs markedly from all those previously described in the deeper and more extensive infuscation of the head, thorax and gaster and the distinct iridescence of the gaster in the worker and female.

Camponotus (Pseudocolobopsis) macilentus var. **pervicus** var. nov.

Worker major. Length 4.5–5 mm.

Very similar to the preceding variety but smaller, more thickset, with proportionally larger head and paler, posteriorly less compressed thorax. Thorax and petiole immaculate, the head with a pale brown, sometimes very faint, spot on the vertex. Bands on the gaster much narrower, each produced anter-

iorly as a point in the middle line. Apical half of scapes in some specimens with a black streak on its anterior and posterior border. The ground color of the body, especially of the thorax, petiole and gaster is paler than in the var. *sapphirinus* and there is scarcely a trace of iridescence.

Worker minor. Length 4 mm.

Very similar to the major worker in color; the head as in the var. *sapphirinus* but the body smaller.

Female. Length 6–6.5 mm.

Smaller than *sapphirinus* and colored like the major worker, but with a faint brownish cloud on the vertex and posterior portion of the mesonotum. Each ocellus has the usual black spot at its inner border. Wings 6.5 mm. long, distinctly brownish yellow, with brownish yellow veins and pterostigma.

Male. Length 4.5 mm.

Also smaller than the corresponding sex of *sapphirinus*, but the gaster is as pale as the head and thorax and the suture between the mesonotum and scutellum is black. The vertex is brownish, the ocelli as usual with a black spot at their inner borders.

Several specimens from a single small colony taken in a *Maytenus obovata* twig at Seymour Bay, Indefatigable Island.

The small dimensions of all four phases show that we are dealing with a distinct variety or subspecies of *macilentus*.

Camponotus (*Pseudocolobopsis*) *macilentus* var. *jacobensis* Wheeler.

Single winged female and male specimens taken by members of the expedition on James Island April 5th, though somewhat darker, agree well with my topotypes collected by Dr. F. X. Williams.

Camponotus (Pseudocolobopsis) macilentus var. **castellanus** var nov.

(Fig. 25).

Worker major. Length 6–7 mm.

Head fully one and one-fourth times as long as broad, subrectangular, scarcely narrowed in front except at the extreme anterior end of the cheeks, the posterior border and sides straight. Cheeks in front convex and projecting on either side of the clypeus, which is subelliptical and notched behind at the indistinct frontal area. Scapes extending beyond the posterior corners of the head a distance equal to the width of their tips. Posterior portion of thorax moderately compressed, the base of the epinotum in profile convex and rounded, decidedly longer than the abrupt, concave declivity. Petiolar node smaller and thinner than in the other varieties, its superior border rather sharp, transverse and feebly concave in the middle.

Sculpture of the mandibles, anterior and dorsal surface of the head rather sharp so that these regions are distinctly less shining than the remainder of the body.

Brownish yellow; coxae and femora paler, thorax and petiole immaculate; mandibles, anterior border of clypeus and cheeks, apical half of scapes, a large spot on the front and vertex, tibiae and tarsi reddish brown. Gaster dark brown, with the posterior border and two transverse spots at the base of each segment, brownish yellow.

Worker minor. Length 4–5.5 mm.

Head very similar to that of the major worker, but with sides feebly round scarcely narrower in front than behind, clypeus shorter, distinctly carinate. Antennal scapes extending about one-third their length beyond the posterior border of the head. Color similar to that of the major but mesonotum, epinotum and petiole brownish. Tibiae only slightly darker than the femora, which

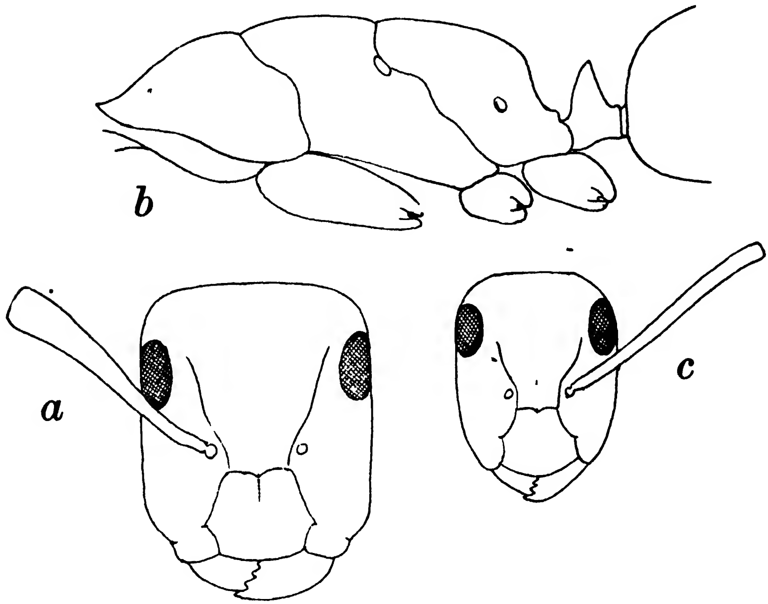

FIG. 25. *CAMPONOTUS (PSEUDOCOLOBOPSIS) MACILENTUS* F. Smith var. *CASTELLANUS* var. nov.

a, head of worker major, *b*, thorax and petiole of same in profile; *c*, head of worker minor.

like the coxae, anterior portion of the head and paler portions of the gaster, are whitish or ivory yellow; knees brownish. The epinotum and petiolar node have the same shape as in the major worker.

Female. Length 7–7.5 mm.

Head large, like that of the major worker, not narrowed in front, but the scapes extend about twice their greatest diameter beyond the posterior corners. Color as in the worker major but the scutellum and a large rectangular spot on the posterior portion of the mesonotum are brown. Wings nearly 8 mm. long, distinctly brownish yellow, with pale brownish pterostigma and pale yellow veins.

Male. Length 5.5–6 mm.

Brownish yellow, the gaster a shade darker, the mandibles, anterior portion of head, pleurae, coxae and femora paler; a small black spot at the base of each fore wing and the usual black spot at the inner border of each ocellus

very distinct. Ocellar triangle more or less brownish. Wings paler than in the female, the pterostigma not darker than the veins, which are pale yellow.

Described from numerous specimens taken from dead twigs and branches of *Bursera graveolens*, abandoned by colonies of *Calotermes pacificus*, on Tower Island. In my paper of 1919 (p. 287) I recorded a major and two minor workers of this variety, among the material taken in 1899 by the "Albatross" on the same island, but the specimens were so greasy and defective that I did not give them a name.

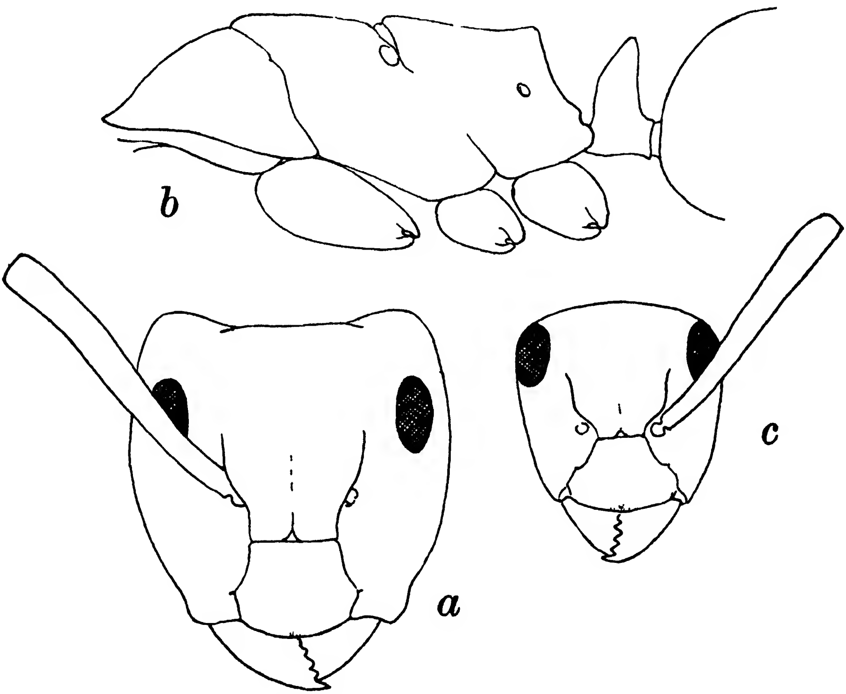

FIG. 26 *CAMPONOTUS (MYRMOCLADOECUS) PLANUS* F. Smith var. *SANTACRUZANUS* Wheeler.
a, head of worker major, *b*, thorax and petiole of same in profile, *c*, head of worker minor.

This variety is distinct in the shape of the head in the worker and female and in that of the petiolar node of the worker. In these phases there is a faint trace of iridescence on the gaster when it is viewed in direct sunlight. The same is also true of the var. *jacobensis*.

Camponotus (Myrmocladoecus) planus F. Smith var. *peregrinus* Emery.

Female (undescribed). Length 7.5 mm.

Compared with the typical *planus* of Charles Island, the differences are mainly in color and pubescence. The body is black, the red areas of *planus*

being more restricted and the red shade of the appendages deeper. On the gaster the appressed pubescence is distinctly shorter, less dense and less silky, so that this region has a different, faintly grayish luster. The pterostigma of the wings is pale yellow, like the veins.

Male (undescribed). Length 5.5 mm.

Also darker than the male of the typical *planus*, the body being jet black; the mandibles, funiculi and trochanters reddish, and the legs and antennal scapes black, slightly tinged with red. Pterostigma and veins of wings pale brown.

Single specimens taken by members of the expedition on Chatham Island, April 7th, 1923.

Camponotus (*Myrmocladoecus*) *planus* var. *isabelensis* Wheeler.

I refer two males taken April 6th, at Tagus Cove, Albemarle Island to this variety.

Camponotus (*Myrmocladoecus*) *planus* F. Smith? var. *santacruzensis* Wheeler.

(Fig. 26).

Specimens from several large colonies were collected at Seymour Bay, Indefatigable Island and on South Seymour Island during the latter part of April. They were nesting in the ground about the roots of trees and shrubs and the large arborescent Opuntias peculiar to the islands. The largest workers attain a length of 7 mm. which is a millimeter more than I recorded for the specimens collected by Dr. Williams. The body has little pilosity and the head is entirely black, not red anteriorly as in the following variety:

Camponotus (*Myrmocladoecus*) *planus* var. *indefessus* Wheeler.

A number of small workers and males were taken by members of the expedition April 1st, 1923 at Conway Bay, Indefatigable Island.

Camponotus (Myrmocladoecus) planus F. Smith? var. **sansalvadorensis** var. nov.

(Fig. 27).

Worker minor. Length 4.5–5.5 mm.

Head trapezoidal, slightly longer than broad, with straight anteriorly converging sides, the eyes at the posterior corners and apparently somewhat more projecting and convex than in the other varieties. Antennal scapes slender and terete at the base, even in the media (in other forms of the species broader and at least slightly flattened), extending somewhat less than half their length beyond the posterior border of the head. Thorax with the base of the epinotum distinctly concave in profile, its posterior angles somewhat dentate, much as in the var. *indefessus*. Pilosity as abundant as in that form but slightly shorter and paler. The appressed pubescence on the gaster is distinctly paler and sparser so that it has only a faint, silvery luster. Body subopaque and of the usual sculpture and color, only the mandibles, anterior edges of the cheeks and the appendages being red.

Male. Length 4–5.3 mm.

Indistinguishable from the male of the var. *peregrinus* Emery.

Six workers and five males, taken April 5th, 1923, on James Island by some of the members of the expedition.

The distinguishing character of this variety seems to be the terete, or cylindrical base of the antennal scapes, which are broader and distinctly more or less flattened in the other forms of the species. Probably the unknown worker major has flattened but very narrow scapes.

The known distribution of the various forms of *C. macilentus* and *planus* is given in the following table, which is merely an amplification of the one published in my paper of 1919. It will be seen that while some form of *macilentus* is known to occur on each of the islands on the list except Chatham, *planus* is unknown from Hood, Bindloe and Tower. I feel confident that it really does not exist on the outlying Tower and that the same statement is probably true of Bindloe, but Hood, judging from its geographical position, should yield a distinct variety. The occurrence of a peculiar variety of *macilentus* may also be predicted for Chatham.

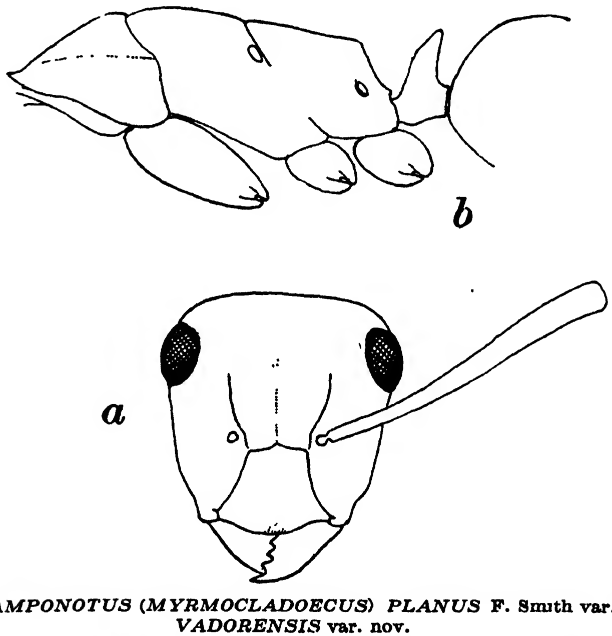

FIG. 27. *CAMPONOTUS (MYRMOCLADOECUS) PLANUS* F. Smith var. *SANSALVADORENSIS* var. nov.

a, head of worker media; *b*, thorax and petiole of same in profile.

	ISLANDS	
Macilentus, typical	Charles	*planus*, typical
(? an undescribed variety)	Chatham	var. *peregrinus*
var. *narboroënsis*	Narborough	var. *fernandinensis*
var. *albemarlensis* var. *vulcanalis*	Albemarle	var. *isabelensis*
var. *duncanensis*	Duncan	var. *pinzonensis*
var. *pervicus* var. *sapphirinus*	Indefatigable South Seymour	var. *indefessus* var. *santacruzensis*

var. *hoodensis*	Hood	(? an undescribed variety)
var. *barringtonensis*	Barrington	var. *fidelis*
var. *jacobensis*	James	var. *sansalvadorensis*
var. *bindloensis*	Bindloe	(? absent)
var. *castellanus*	Tower	(absent)

In conclusion I append a complete list of the Galapagos Formicidae with their distribution, so far as it has been ascertained from the materials collected by the Harrison Williams and previous expeditions. For reasons given above I have omitted *Camponotus senex* and have substituted *Cylindromyrmex williamsi* for *C. striatus*. As revised the list shows that forty-two different forms have so far been taken in the islands, that there are only five species, but twenty-eight varieties or subspecies, peculiar to their fauna and that some nine species are common tropicopolitan vagrants, or tramps. The list also shows that nearly twice as many ants (12) are recorded from Indefatigable as from any of the other islands. This merely means, of course, that more numerous collections have been made in that one locality.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

Names of Species, Subspecies and Varieties	Narborough	Albemarle	Duncan	Charles	Hood	Chatham	Barrington	Indefatigable	Eden Rock	South Seymour	Daphne	James	Tower	Bindloe	Abingdon
Cylindromyrmex williamsi	—	—	—	—	—	—	—	×	—	×	—	—	—	—	—
Ponera beebei	—	—	—	—	—	—	—	—	—	—	—	—	×	—	—
Odontomachus haematoda subsp bauri.	—	—	—	×	—	×	—	—	—	—	—	—	—	—	—
Pheidole williamsi	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—
var. seymourensis	—	—	—	—	—	—	—	—	—	×	×	—	—	—	—
Pheidole sp.	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—
Solenopsis saevissima	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—
Solenopsis geminata	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—
Solenopsis globularia var. galapagaea	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—
var. pacifica	—	×	—	—	—	—	—	×	—	—	×	—	×	—	—
var. rubida	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
Monomorium pharaonis	—	—	—	—	—	—	—	×	—	—	—	—	—	—	×
Monomorium floricola	—	—	—	—	—	—	—	—	—	—	—	—	×	—	—
Tetramorium guineense	—	×	—	—	—	×	—	—	—	—	—	—	×	—	—
Tetramorium simillimum	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—
Dorymyrmex pyramicus subsp. albemarlensis	—	×	—	—	—	—	—	×	×	×	—	—	—	—	—
Tapinoma melanocephalum	—	—	—	—	×	×	—	×	—	—	—	—	×	—	—
Prenolepis longicornis	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—
Prenolepis vividula var itinerans	—	—	—	—	—	×	—	×	—	—	—	—	—	—	—
var. edenensis	—	—	—	—	—	—	—	—	×	—	—	—	—	—	—
Prenolepis fulva subsp. nesiotis	—	—	—	—	—	—	—	×	—	—	—	×	—	—	—
Camponotus macilentus	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—
var. jacobensis	—	—	—	—	—	—	—	—	—	—	—	×	—	—	—
var. albemarlensis	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—
var. vulcanalis	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—
var. duncanensis	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—
var. narboroënsis	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—
var. hoodensis	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—
var. barringtonensis	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—
var. bindloënsis	—	—	—	—	—	—	—	—	—	—	—	—	—	×	—
var. sapphirinus	—	—	—	—	—	—	—	×	—	×	—	—	—	—	—
var. pervicus	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—
var. castellanus	—	—	—	—	—	—	—	—	—	—	—	—	×	—	—
Camponotus planus	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—
var. peregrinus	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—
var. isabelensis	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—
var. indefessus	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—
var. santacruzensis	—	—	—	—	—	—	—	×	—	×	—	—	—	—	—
var. fidelis	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—
var. fernandinensis	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—
var. pinzonensis	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—
var. sansalvadorensis	—	—	—	—	—	—	—	—	—	—	—	×	—	—	—
Number of forms on each island	2	7	2	6	3	6	2	13	2	5	2	3	6	1	1

TRIUNGULIN LARVAE FROM THE WILLIAMS GALAPAGOS EXPEDITION

TRIUNGULINS OF A MELOID BEETLE BORNE BY XYLOCOPA, WITH REMARKS ON THIS TYPE OF LARVA IN THE COLEOPTERA AND STREPSIPTERA.[1]

BY CHARLES T. BRUES.

(Figures 28–32 incl.).

Among the numerous specimens of the bee *Xylocopa transitoria* Pérez collected by the members of the Williams Expedition to the Galapagos, there is one female from South Seymour Island, taken by William Beebe, which is of particular interest. This specimen bears attached to the posterior part of the thorax a large number of Coleopterous triungulins which undoubtedly belong to some beetle parasitic upon this large bee.

The Xylocopa in question was preserved in a vial of alcohol and after its long voyage to New York and subsequent shipment to Boston still retains most of the triungulins attached to its body (Fig. 28). These now number approximately 100, in addition to some twenty-five which have become detached during transit. With the exception of two on the basal concavity of the abdomen, all are confined to the scutellum and to one side of the posterior declivity of the propodeum where they form a dense yellow mass. Each triungulin rests with the posterior end of its body directed away from the body of the bee. Examination of the individual triungulins shows that they maintain this position by closing the mandibles about a single body-hair of the bee, or by grasping several together in such a way that the branched hairs pass through the space between the closed mandibles and are pressed between these and the interior surface of the head, while the apical portion of the hair passes backward along the ventral surface of the body. Thus attached, the triungulin is further securely anchored by a peculiar modification of the mandibles which are not toothed along the inner

[1] Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No 231

First form on press February 27, 1924

FIG. 28. XYLOCOPA TRANSITORIA Perez

Attached to the thorax is a group of triungulins of *Horia maculata* Swed.

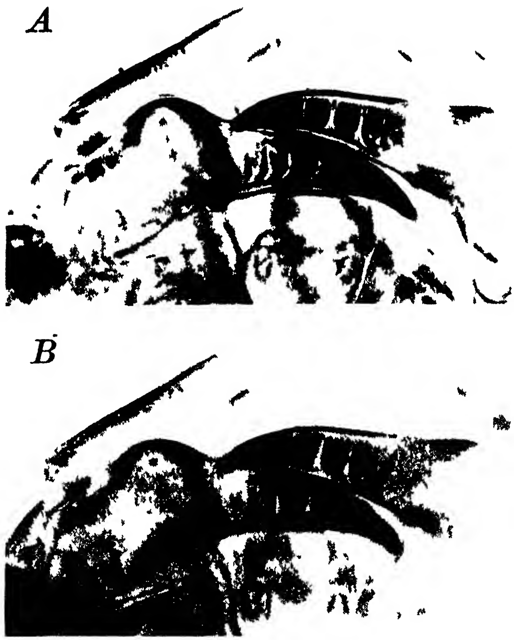

FIG. 29. Mandibles of a triungulin of *HORIA MACULATA* Swed.
In microphotograph -A- the lens has been focussed at a higher level than in -B- to show the narrow spaces between the teeth at their bases.

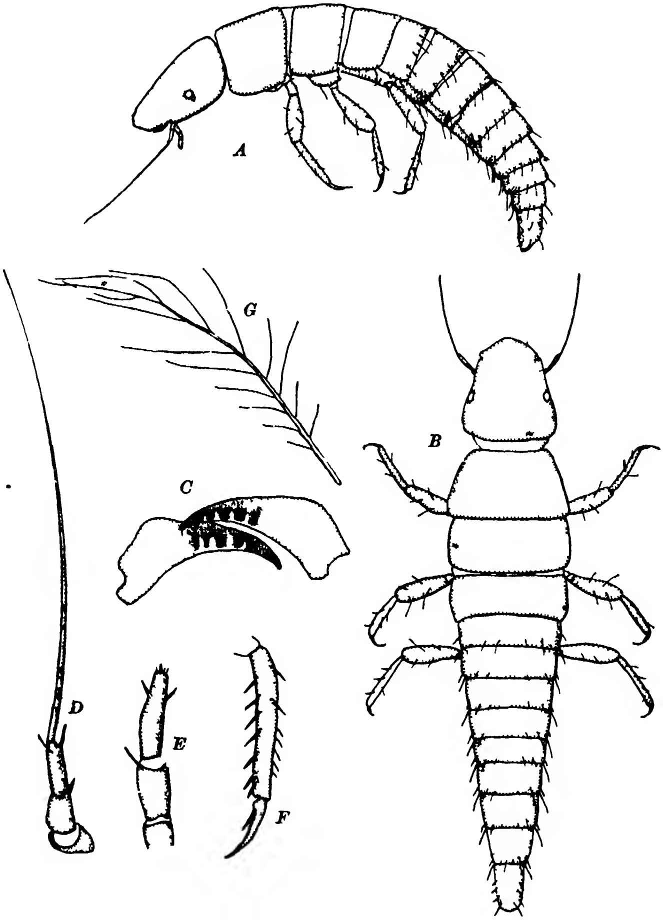

FIG. 30. Triungulin of *HORIA MACULATA* Swed.
A, lateral view; B, dorsal view; C, mandibles; D, antenna; E, palpus; F, tibia and tarsus of hind leg; G, body-hair taken from propodeum of *Xylocopa transitoria* Pérez.

cutting edge as is usual among insects. They are instead provided each with a series of tubercular projections or teeth on the upper surface, that is to say on the side which faces the under surface of the head. Thus when the mandibles are closed (Fig. 30, C; Fig. 29) the projections form a transverse line, each extending backward and serving to catch the hair (Fig. 30, G) so firmly in the notches between them that the triungulin is able to retain its hold continuously in spite of the active movements of its conveyer.

As will appear later, these triungulins are undoubtedly larvae of a species of Horia, most probably *H. maculata* Swed. They may be described as follows:

Length 1.3–1.7 mm. Uniformly pale brownish yellow, the eyes intensely black. Head much flattened; thorax less so, and abdomen nearly cylindrical in cross section. Head gradually narrowed anteriorly, the front border acutely rounded. Eyes set just back of the middle, small, oval, appearing in specimens that have been cleared in potash as composed of two ommatidia, a larger dorsal and a smaller ventral one. Antennae three jointed, very small; basal joint short, second and third cylindrical, the third more slender and slightly the longer; apical seta long and so extremely thin apically that its tip is difficult to see even with an oil-immersion lens; fully as long as the head. Palpi longer than the antennae; basal joint short; second and third longer; tip of third joint truncate and bearing a few very minute setae. Mandibles large, concealed beneath the head when closed; acutely pointed at tip; upper edge (*i. e.*, the surface next to the lower surface of the head) bearing four tooth-like ridges that extend backward. Thoracic segments longer than the abdominal ones; prothorax the longest and the metathorax shortest; all three entirely destitute of bristles. Abdomen long and tapering, composed of nine segments in addition to an apical membranous process (so-called anal sucker; not shown in the figure) which is sometimes extruded to nearly the length of the last segment; all the segments bear along the sides and posterior edge a number of bristly hairs. Legs moderately long, all three pairs of about the same size and form; femora somewhat thickened; tibiae more slender; tarsus (fig. 30, F) reduced to a single curved claw on each leg. The femora and tibiae are sparsely clothed with bristly hairs and each coxa bears one or two bristles.

Having noted the remarkable structure of the mandibles in this species, I was led to examine other triungulins for similar modifications and find that such exist in at least one other form. A female Andrena collected by Prof. W. M. Wheeler at Colebrook, Connecticut, bears attached to the body-hairs, several triungulins quite similar to those on the Xylocopa from the Galapagos, although differing in a number of characters. This larva is probably a Meloid of the tribe Zonitini represented in this region by at least one species, *Zonitis bilineata* Say. According to the studies of Cros ('13; '20) the larvae of this group and of the tribe Sitarini are distinguishable from the triungulins of other Meloidae and of the Rhipiphoridae by the presence of a pair of dorsal projections arising in the membrane between the eighth and ninth abdominal segments, formerly thought to be suckers or attachment organs, but shown by Cros to be respiratory organs. These are present in this triungulin, which further has bi-ocellate eyes and tarsal claws with a long basal bristle. The mandibles are strikingly similar to those of the Horia larvae from

the Galapagos, but are less highly modified. The teeth are on the upper surface of the mandible, but are closer to the edge and actually project over the edge in optical section. This type of dentition is therefore intermediate between that with the usual dentate inner edge and the modification described above where the teeth have shifted away from the edge and have come to lie entirely on the dorsal surface.

Unfortunately no Meloidae or Rhipiphoridae are known from the Galapagos and it is impossible to determine positively the systematic position of the larvae. There are no records which I can find of Xylocopa bearing triungulins in other places where these bees are abundant, but as I hope to show from their structure in conjunction with published records of Meloid beetles reared from the nests of Xylocopa in other parts of the world, the presumptive evidence is very strong that the Galapagos triungulins are those of *Horia maculata* Swed.

In general form, tarsal structure and by the presence of biocellate eyes they are very similar to the larvae of Sitaris, Hornia and other Sitarini and Zonitini as described by Cros ('20), but the respiratory horns near the apex of the abdomen are entirely lacking and they are present in all the members of these tribes in the first larval stage, so far as is definitely known.[2] As mentioned above the form of the mandibles is also different although easily to be derived from a type which occurs in these tribes.

The triungulins of several Meloini are well known and were familiar objects to several of the earlier entomologists. They were observed by Goedart, DeGeer, Kirby and Dufour (who first called them triungulins in 1828), and as early as 1845 Newport was able to explain their presence attached to the bodies of bees on the basis of their larval habits. Later the larva of Meloë was studied by Riley ('77), by Beauregard ('90) and notably by Cros in several recent papers. The legs terminate in three similar curved claws, of equal thickness or sometimes with the median one stouter and straight, two types very aptly termed by Cros "en fourche" and "en trident de Neptune." The head bears a single eye on each side and the abdomen is furnished with long caudal bristles. Obviously the present larva does not belong to this group, although some species

[2] Williams and Hungerford ('14) figure a triungulin which they suspected was that of Hornia, but this is quite likely referable to some other genus of Meloidae.

are bee-parasites and are regularly found attached to the bees. All do not cling to the hairs, however, and one remarkable species, *Meloë cavensis*, actually perforates the intersegmental membrane of the bee by forcing its flat and pointed spiny head between the abdominal plates of its unhappy mount.

Triungulins of a number of genera of the tribe Lyttini are known but none have been found attached to Hymenoptera as they appear to depend entirely upon their own powers of locomotion to locate their hosts. The claws are bifid or tripartite and the eyes are placed far forward, on the anterior half of the head. Our larvae could hardly be referred to this group.

The early larva of the small tribe Horiini is known through a careful study of Bugnion ('09) on the larva of the Ceylonese *Cissites testaceus* and by supplementary details given later by Cros ('20). This larva resembles that of the Zonitini-Sitarini, but lacks the apical abdominal horns, although it is supplied with two caudal setae. The eyes are composed of a single ocellus according to Cros, but there is a suggestion of the eye being double in Bugnion's figure. The leg claws are bifid, consisting of a stout claw with a smaller appendage at the base. In all, the larva is very similar to the Xylocopa-parasite which I have described, and furthermore Cissites inhabits the nests of Xylocopa. Bugnion obtained his material from the galleries of the common Indian *X. tenuiscapa* Westw., with which it has been known to occur since 1833 when Westermann found it in Xylocopa nests where he mistook it for the primary agent excavating the wood. The main differences between Cissites and the form in question from the Galapagos lies in the bi-ocellate eye of the latter, as well as the smaller bristle at the base of the tarsal claw (*cf.* Fig. 31, c.) and in the dention of the mandibles, which are said to be feebly denticulate on the edge in Cissites by Cros, although Bugnion failed to detect any teeth and described them as smooth.

According to Gahan ('08) the genus Cissites is restricted to the Old World, and the Neotropical species which are very closely related are to be placed in Horia. Horia was found associated with Xylocopa nearly a century ago by that well known naturalist and keen observer, the Rev. Landsdown Guilding ('25) on the island of Barbados. He described the later larva of a Horia which he referred to *H. maculata* Swed., but which according to Champion ('92) was undoubtedly that of *H. auriculata* Dugès. Guilding also shows one

of the large brightly marked beetles on the colored plate which accompanies his paper. It is now evident that Guilding was correct in his belief that the Horia is parasitic in the nests of the New World Xylocopas, just as Cissites is in those of Africa and Asia. Champion was not inclined to accept the accuracy of Guilding's conclusions, for he says, in referring to *Horia auriculata* (*loc. cit.* p. 372: "Specimens of this species were chiefly obtained by me in the open verandahs of houses, and on more than one occasion I have observed the insect crawling on the wood-work in the close vicinity of the

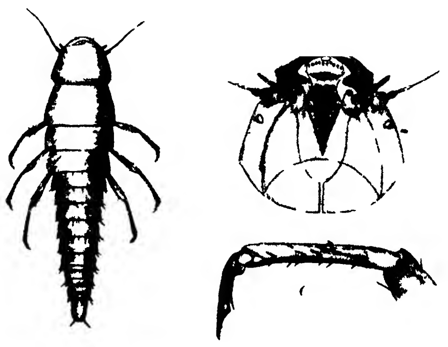

FIG. 31. Triungulin of *CISSITES TESTACEUS* Fabr.
A, dorsal view; B, ventral view of head; C, tibia and tarsus of hind leg. (after Bugnion)

nests of a large blue wasp, these nests being commonly found in such places. It is probable, therefore, that *H. auriculata* really preys upon this wasp, and not upon Xylocopa."

There can be little question that the triungulins which I have described belong to *H. maculata* or possibly to some as yet undescribed species, for *maculata* occurs from Mexico southward to Ecuador, while *auriculata* is not known south of Costa Rica.

One other record of a Meloid associated with Xylocopa has come to my attention. This is an observation by Davidson ('07) and relates to the North American *Nemognatha scutellaris* Lec. which he reared from a cell of Xylocopa, probably *X. orpifex*, as well as from another bee of the genus Alcidamea.

The first stage larvae of the family Rhipiphoridae are not so well known as those of the Meloidae, but those of several genera have been described with considerable care. Like some of the Meloids, Rhipiphorus (*Myodites* auct.) is parasitic on various bees

(Melander & Brues '03; Pierce '04). The triungulin of *R. solidaginis* Pierce has been figured by Silvestri ('06) whose drawing is reproduced in the accompanying figure (Fig. 32, B). It will be seen that this larva is extremely similar in nearly all details to the supposed Horia from Xylocopa described above. Silvestri does not state from whence his specimens came, but as he does not question the identification there is presumably no reason to doubt its accuracy. In his figure of the head three ocelli are shown on one side and two on the other, the larger number being characteristic of Rhipiphoridae

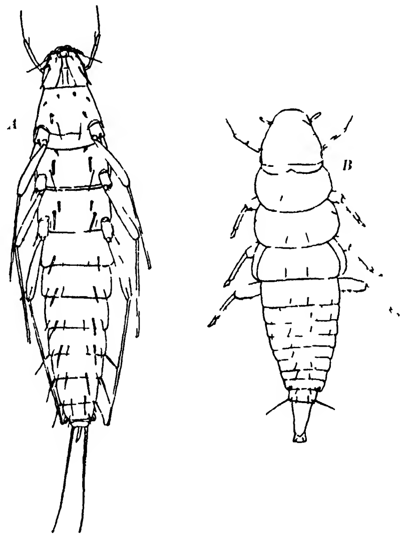

FIG. 32. A, triungulin of *RHYZOSTYLOPS INQUIRENDUS* Silv. Ventral view (after Silvestri)
B, triungulin of *RHIPIPHORUS SOLIDAGINIS* Pierce. Dorsal view (after Silvestri)

and two being characteristic of certain Meloids. The mandibles do not appear to bear any teeth. Pierce's figures ('04) are not sufficiently detailed to show the form of the eyes, nor of the tarsal claws in this species, but he describes the leg as "terminated by a curved claw, almost concealed by a large semi-transparent elliptical pulvillus of twice its length," which is certainly very different from the tarsus in the Meloidae. The first larva of Rhipidius has been several times observed and *R. denisi* Chobaut is well figured by Chobaut ('19). It may be considered together with *Rhyzostylops inquirendus* Silvestri ('06). The latter is a very aberrant Rhipiphorid known

only from the extremely degenerate female and the first-stage larva. Silvestri considered this insect as more or less intermediate between Rhipidius and the Strepsiptera. The triungulins of these two genera are remarkably similar (fig. 32, A, Rhyzostylops). The legs are more slender than those of the Meloidae, with long thin tibia, tipped by a pair of extremely minute claws, the eyes are multi-ocellate and the body is heavily bristled. In at least some species of Rhipidius (Murray '70), there is a large pulvillus between the tarsal claws. The mandibles are simple, without teeth.

In another Rhipiphorid, Macrosiagon (=*Emenadia*) which occurs in the nests of certain solitary wasps (Odynerus, Eumenes, etc.) there is a pulvillus also, much as in Rhipiphorus.

The structure and arrangement of the claws of the legs of Meloid and Rhipiphorid triungulins is of particular interest in connection with the possible relationship of these beetles to the Strepsiptera. The triungulins of the latter are usually destitute of claws on the legs, which are tipped with flattened sucker-like pads. In some Strepsiptera, however, two pairs of legs bear the terminal sucker while the other is provided with a single claw. This is the case in *Xenos nigrescens* Brues as figured in a former paper ('05) and a recent re-examination of these triungulins leaves no doubt as to the actual dissimilarity of the legs, the hind pair each with a claw and the four anterior legs each with a terminal disc. The same arrangement occurs in an undetermined genus "allied to Xenos" figured by Perkins ('05) and in Stylops.

Terminal pads on all three pairs of legs occur also in some Strepsiptera, at least they have been so figured in Stichotrema (Pierce '18). Single claws on all the legs are present in several genera, *e. g.*, Elenchus (Perkins '05), Pentozocera (=*Bruesia* Perk.) (Perkins '05) and in *Stylops californica* Pierce (Pierce '18) although the presence of discs on the four anterior legs of some other species of Stylops would make it seem probable that *S. californica* must represent another genus.

Triple claws on each leg have been found by Pierce ('18) in Callipharixenos which thus approaches the typical Meloid triungulin in tarsal structure, although the claws are very delicate and appear as three slender filaments attached to a distinct elongate tarsal joint.

Thus it will be seen that the Strepsipteran triungulins show a great variation in regard to the terminal armature of the legs and

exhibit no constant character which will serve to distinguish them from those of either the Meloidae or Rhipiphoridae. There appears to be no distinguishing characteristic in the presence of long caudal setae as these while present in all Strepsiptera are as well developed in many Meloids and Rhipiphorids. Whether the difficulty of distinguishing the larvae of the two groups indicates genetic relationship is of course not altogether clear, but the many similarities strengthen the opinion held by many entomologists that the Strepsiptera are more closely related to the Coleoptera than to any other group of insects.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

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Zoologica Vol. V. No. 12.

CHILOPODS

OF THE WILLIAMS GALAPAGOS EXPEDITION

BY RALPH V. CHAMBERLIN

(Plate VI, figs. 1–4)

This expedition, initiated and financed by Mr. Harrison Williams, was sent out under the auspices of the Department of Tropical Research of the New York Zoological Society. While but few centipedes were secured by Mr. William Beebe and his associates on this expedition, these represent two of the three species previously recorded from this archipelago, and, in addition, two new species, one of which typifies a new genus in the family Schendylidae. Thus the number of species now known from these islands is raised to five. Four of these species are indigenous.

In a previous paper (Psyche, 1914, 21, p. 85) the writer erroneously listed, among species from the Galapagos Islands, *Cryptops navigans* Chamberlin and *Mecistocephalus parvus* Chamberlin; but these forms were, in fact, taken on Clipperton Island, which lies fifteen hundred miles north-west of the Galapagos group.

The only one of the five species not represented in the present collection is *Orphnaeus brevilabiatus* (Newport). This is a very common geophiloid throughout the warmer parts of both hemispheres. One specimen of it was taken on Hood Island by the Stanford Expedition of 1898–99.

The types of new species are in the Department of Tropical Research of the New York Zoological Society.

Family CRYPTOPIDAE

Cryptops beebei, sp. nov.

General color yellowish.

Head with sides subparallel over the middle portion. Without paired sulci.

First dorsal plate with a cervical sulcus which is angularly bent back at the middle. Paired longitudinal sulci extend from caudal margin to the cervical sulcus. Each longitudinal sulcus is furcate at its anterior end.

Paired sulci present on the second and subsequent tergites. Last plate with a median longitudinal depression which does not extend to the caudal angle.

Prosternum not punctate or distinctly furrowed. Anterior margin convex; bearing 4 + 4 setae of which the ectal on each side is reduced or may

First form on press April 28, 1924.

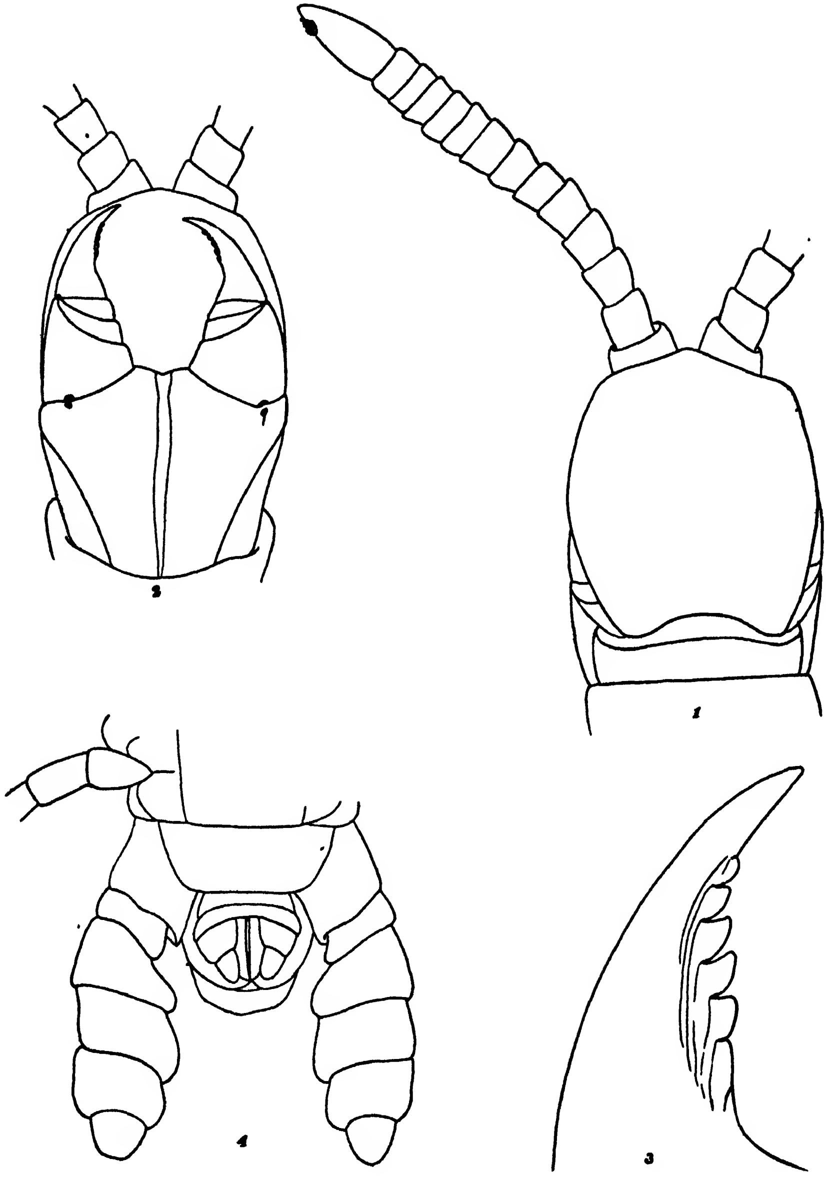


PLATE VI. *NANNOPODELLUS PURPURASCENS*, sp. nov.

1, anterior end, dorsal view; 2, prehensors, ventral view; 3, claw of right prehensor, ventral view, more highly enlarged; 4, caudal end, ventral view.

be indicated only by the basal nodule. A little caudad of the anterior margin are in addition 2 + 2 bristles. Elsewhere the setae are short and sparse.

Ventral plates smooth, not punctate. Last ventral plate trapeziform, the sides convex, more strongly rounded toward and about the posterior corners; caudal margin a little convex.

Coxopleurae caudally subtruncate.

Spiracles moderate, in part a little longitudinally elliptic.

Tarsi of anterior legs uniarticulate.

Third joint of last legs armed ventrally and laterally with numerous spines and spinescent setae of which the ventral ones are stouter; ventral surface with a median longitudinal space free from spines. Fourth joint with similar but fewer spines and with a similar spine-free median space. Fifth joint (tibia) with a series of four ventral teeth. The sixth joint with two ventral teeth. Ultimate joint bearing only setae.

Length, 16 mm.

Locality.—Tower Id. Two specimens taken 28 April, 1923.

In characters of the anal legs this species resembles *Cryptops navigans* Chamberlin of Clipperton Id. From that species, however, it is readily distinguished in having paired sulci on the first as well as on the second tergites, in having setae on the anterior margin of the prosternum, etc. The present species is named for Mr. William Beebe, leader of the expedition, by which the types were secured.

Family SCOLOPENDRIDAE

Scolopendra galapagoensis Bollman

Proc. U. S. Nat. Mus., 1889, 12, p. 214.

Scolopendra galapagoensis Chamberlin

Psyche, 1914, p. 86.

In the stomach of a Galapagos hawk, *Buteo galapagensis*, shot on South Seymour, April 19th, 1923, were found the well-preserved posterior portions of five specimens of this large centiped. Heads and anterior segments were missing. From a second hawk, killed at the same place and on the same date, fragments of two other individuals of this centiped were removed. In this case the head end of one specimen is present and entire, while of the second specimen the head proper is missing although the poison-jaws are present. Fragments, including head of another specimen of the same species, were found in the stomach of a short-eared owl, *Asio galapagensis*, taken April 28th, 1923 on Tower Id.

This species would seem to be the most abundant, or at least certainly the most conspicuous, chilopod of the Galapagos Is. It was previously recorded from Hood, Chatham, Bindloe, Narborough, and Albemarle Islands.

Family SCHENDYLIDAE

Pectiniunguis albemarlensis Chamberlin

Pectiniunguis americanus Chamberlin (nec Bollman)

Ent. News, 1913, p. 122.

Pectiniunguis albemarlensis Chamberlin

Psyche, 1914, 21, p. 86; *Proc. Cal. Acad. Sci.*, 1923, ser. 4, 13, p. 394, f 3.

This species was based upon a single female specimen with 61 pairs of legs which was taken upon Albemarle Id. by R. E. Snodgrass while a member of the Stanford Galapagos Expedition of 1898–'99. Two additional specimens were taken on Tower Id. by the Williams Expedition on the 18 and 27 April, 1923, respectively. These are likewise females. One, with sixty-one pairs of legs, has the prebasal plate exposed and the coloration normal. It is 62 mm. long. The other individual has 65 pairs of legs and has the prebasal plate covered, apparently by artificial retraction of the cephalic plate in the alcohol. The cephalic plate is somewhat differently shaped and the antennae are shorter. The geminate black dorsal stripe is absent or only vaguely indicated in the posterior region. It is 45 mm. long.

Nannopodellus, gen. nov.

Mandibles with a dentate lamella which is typically tripartite.
Labrum pectinate at sides, truly dentate(?) at middle.
Claw of the palpi of the second maxillae with margins pectinate.
Sternites without pore-areas.
Coxopleurae of last legs each with two homogeneous glands.
Anal legs six-jointed; without claws.

Genotype.—*N. purpurascens* sp. nov.

Related to *Nannophilus* in general features, but different in the absence of ventral pores on the sternites. It is at present impossible to say just what relationship the present form bears to the several South American species placed by Silvestri in the genus *Nannophilus*, though it is quite possible they are congeneric. The species clearly referable to *Nannophilus* have been found in the Mediterranean region.

Nannopodellus purpurascens, sp. nov.

(Plate VI, figs. 1–4)

The general ground color is yellowish, but the body is conspicuously marked throughout its length above, below and laterally with numerous purplish marks and dots which tend to form longitudinal stripes.

The head shows no frontal suture. It is longer than wide in the ratio 8 : 7, and is widest at middle of its length. Caudal margin incurved. Anterior margin obtusely angular. (fig. 1.)

Antennae 1.8 times as long as the cephalic plate. The ultimate article as long as, or longer than, the three preceding articles taken together. (fig. 1.)

Prebasal plate exposed.

Basal plate very short, its exposed area rather more than five times as wide as long. (fig. 1.)

Claws of prehensors when closed not attaining front margin of head; unarmed at base but serrate along mesal side of middle portion as shown in figs. 2 and 3. Proximal joints of prehensors unarmed. Prosternum as exposed a little wider than long, without definite chitinous lines.

The last ventral plate very wide; covering the coxal pores on each side. Pores evident only after special clearing of the specimen. (See further, fig. 4.)

Anal legs of male very stout. (fig. 4.)

Pairs of legs in the male, fifty-three.

Length, about 16 mm.

Locality.—South Seymour Id., 20 April, 1923.

One male which is in poorly preserved condition.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

THE COCCIDAE
OF THE WILLIAMS GALAPAGOS EXPEDITION

By Harold Morrison

Bureau of Entomology, U. S. Department of Agriculture, Washington, D.C.

(Figs. 33 to 37 incl.)

This expedition was sent out by the Department of Tropical Research of the New York Zoological Society. The Coccidae reported on below were very kindly offered to the writer for study by their collector, Dr. William Beebe, who has also furnished all the collection data quoted for the different species represented.

The writer is indebted to Miss Amalia Shoemaker for the accompanying figures showing the structural details of the newly described species.

In spite of its very obvious deficiencies, the scheme of classification given in the Fernald Catalogue of the Coccidae of the World, 1903, has been followed in assigning the species to genera and subfamilies.

Subfamily Margarodinae

Genus *Margarodes* Guilding

Margarodes similis sp. nov.

Adult Female.—(Description drawn up from fragments of one specimen only.) Nothing available regarding the normal external appearance, actual size or shape of body; the single antenna available 5-segmented, with the 4th segment incompletely divided twice, the antennae therefore probably normally 7-segmented; measurements of the segments in microns as follows: I, 71; II, 61; III, 22; IV, 100; V, 64; antennae beset with the usual stout spines and setae, not displaying any apparent peculiarities; legs characteristic for the genus, the thickened claw of the posterior pairs somewhat more slender than the same part in the legs of the nearest known relative, *rileyi;* mouthparts presumably wanting; thoracic spiracles very considerably larger than the abdominal, with a distinct lateral chitinous bar and four or perhaps more bilocular center, multilocular disk pores within the external opening, and two tiny pores externally immediately adjacent to the opening; abdominal spiracles much smaller, tubular, each with a pore collar of about 4, similar, bilocular center pores, spiracles presumably present in seven pairs, although only a single spiracle available for examination; derm pores nearly circular, with a large quinquilocular center surrounded by a band of smaller loculi, this in turn surrounded by a heavy

First form on press April 28, 1924.

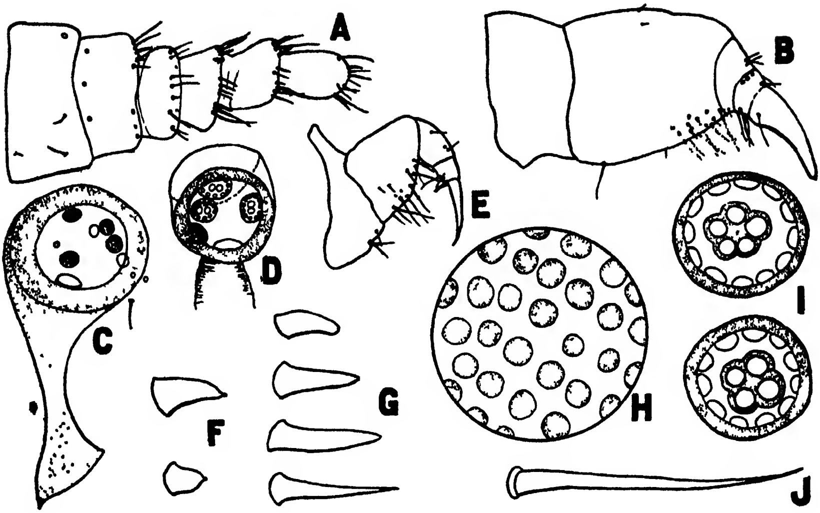


FIG. 33 *MARGARODES SIMILIS*, sp. nov.

A, antenna, × 120, B, fore leg, × 60, C, thoracic spiracle, × 230; D, abdominal spiracle, × 530; E, middle leg, × 60; F, body spines of *Margarodes rileyi*, for comparison × 530; G, body spines, × 530, H, derm, showing papillae, × 530; I, detail of disk pore, × 1500; J, detail of body seta, × 530; all adult female.

collar; no other sorts of derm pores except those described in connection with the spiracles located; all of the derm available for examination bearing many, rather crowded, uniformly distributed, slightly convex to nearly hemispherical papillae; derm with numerous, moderately stout spines with apices varying, according to the stoutness, from acutely to almost obtusely pointed, and with numerous rather stout setae; the arrangement of these spines and setae not ascertainable from the fragments available for study; anal tube not available and no ventral cicatrices evident.

Immature Female Tests.—Of moderate size, made up of more or less distinctly overlapping layers, golden to reddish-brown in color, not differing in any evident particulars from the tests of *M. rileyi* and *M. formicarum*.

This species has been described from a single, very fragmenta y, adult female and from a considerable number of tests of the immature stage female collected by Dr. William Beebe with the following data: "from rootlets of *Maytena*, Seymour Bay, Indefatigable, April 25" (Invert. no. 2263) (holotype adult female and intermediate female tests); "from roots of yellow-plumed ground plant, Eden Island, N. W. Coast of Indefatigable, April 8th" (Invert. no. 2219); "from debris under *Bursera* close to beach, South Seymour, north-east of Indefatigable, April 19th" (Invert. no. 2262); "Seymour Bay, Indefatigable," no date, host nor number; (all of these last represented by female tests only).

The type female and a number of the tests are in the U. S. National Collection of Coccidae.

This species, on the basis of the material available for study, is extremely closely related to *M. rileyi* Giard, as this species is identified from the Florida Keys, differing positively, so far as can be observed, only in having the body spines normally pointed at apices and without the nipple-like continuation of each spine apex which appears to be characteristic of *M. rileyi.*

Subfamily ORTHEZIINAE

Genus *Orthezia* Bosc.

Orthezia galapagoensis Kuw.

This species of *Orthezia* is represented in the collection by two lots of material as follows: "from stems of *Heliotropium parviflorum*, Seymour Bay, Indefatigable, April 25" (Invert. no. 2369) and on "*Bursera*, Duncan, April 25" (Invert. no. 2390).

Subfamily DACTYLOPIINAE

Genus *Eriococcus* Targ.

Eriococcus papillosus sp. nov.

Sac of Female.—Broad oval, moderately convex, the single sac available appearing, after immersion in alcohol, thin and fragile, white; length about 3 mm., width about 2 mm.

Adult Female.—Length as mounted 2.5 mm., width 1.7 mm.; oval, tapering more or less distinctly at apices; derm clearing completely on treatment with caustic potash, except for anal lobes; antennae normally 6-segmented, the measurements in microns of the segments of those available for examination as follows: I, uncertain, due to distortion; II, 36–46; III, 104–118; IV, 22–25; V, 18–25; VI, 36–40; beak and spiracles not unusual for the genus, the former about 100 μ wide and 140 μ long; legs not unusual for the genus, the measurements of a middle leg in microns as follows: coxa about 114, trochanter 75, femur 157, tibia 132, tarsus 118, claw 36, tarsal digitules 54, claw digitules 39; tarsal digitules longer and stouter than those of claw, all distinctly knobbed at apices, tarsal claw with the usual denticle; anal lobes not unusually large nor prominent for the genus, chitinized, with the usual three dorsal spines, two ventral setae, and an apical seta, the latter about 286 μ long; anal ring with the usual single complete row of pores and eight setae, the longest of these about 121 μ; preapical setae of anal lobes about 96 μ long; body bearing rather numerous large spines over the dorsum as well as at the margin, these, on the abdomen at least, arranged in more or less distinct transverse segmental bands, with spines of smaller size interspersed between the larger, all these spines stout and only slightly constricted at base, tapering almost uniformly to a slender but bluntly rounded tip; those of anal lobes proportionately distinctly more slender than the remainder; longest anal lobe spine about 40 μ in length, largest marginal spine about 54 μ in length, largest dorsal spines about 50 μ in length, smallest dorsal spine about 22 μ in length; large tubular ducts with the tube of average length, the inverted cup wide and fairly deep, these ducts scattered in segmental arrangement over the dorsal surface, and at the margins ventrally; body also

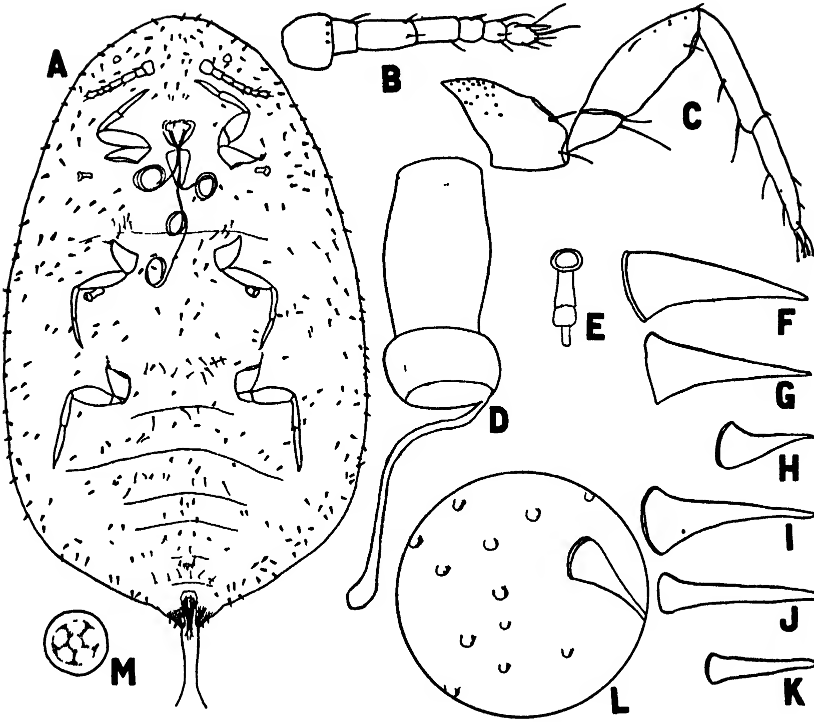


FIG. 34. *ERIOCOCCUS PAPILLOSUS*, sp nov.

A, outline of body, optical section, showing appendages, spines and larger setae, × 40; B, antenna, × 120; C, posterior leg, × 120; D, large tubular duct, × 1500; E, small tubular duct, × 1500; F, marginal spine, × 530; G, large dorsal spine, × 530; H, small dorsal spine, × 530; I, apical anal lobe spine, × 530; J, outer anal lobe spine, × 530; K, inner anal lobe spine, × 530; L, portion of derm showing papillae, × 530; M, disk pore, × 1500; all adult female.

with minute symmetrical tubular ducts dorsally, but in much fewer numbers than the preceding; ventrally with smaller, quinquilocular disk pores; derm dorsally and at margins bearing numerous, but scattered, tiny papillae or tubercles rather uniformly distributed over the whole area; largest ventral abdominal seta about 50 μ.

No other stages available for examination.

This species has been described from two specimens mounted on slides, collected in the Galapagos Islands in company with a large number of specimens of *Orthezia galapagoensis* and having the following data: "From stems of *Heliotropium parviflorum*, Seymour Bay, Indefatigable, April 25." (Invert. no. 2369.)

The types are in the U. S. National Collection of Coccidae.

Of the species of the genus *Eriococcus* with which the writer is familiar,

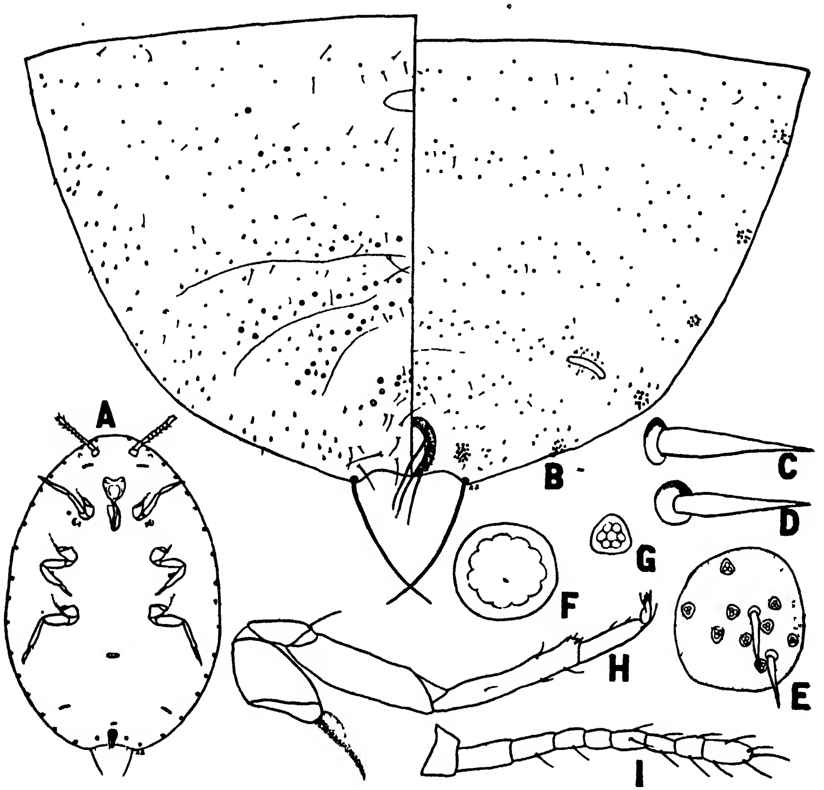


FIG. 35. *PHENACOCCUS PARVUS*, sp. nov.

A, outline of body, optical section showing position and relation of parts, × 21; B, apex of abdomen, dorsal and ventral, × 88; C, apical cerarian spine, × 1500; D, penultimate cerarian spine, × 1500; E, lateral abdominal cerarius from unexpanded adult, × 530; F, multilocular disk pore, × 1500; G, triangular pore, × 1500; H, middle leg, × 120; I, antenna, × 120; all adult female.

this appears to approach most closely *Eriococcus palmeri* Ckll., described from Lower California, from which species it differs most obviously in the larger size and more elongate and more slender antennae as well as in the possession of the cuticular tubercles, these not being in evidence in *E. palmeri*.

Genus *Phenacoccus* Ckll.

Phenacoccus parvus sp. nov.

Adult Female.—Only alcoholic specimens available for examination, so no description of normal external appearances can be given; length of fully distended specimens as mounted on slide 1.8 to 2 mm.; width 1.2 to 1.3mm.; normal shape either uniformly oval or very slightly broader behind; derm clearing

completely on treatment with potassium hydroxide in old specimens, but retaining faintly suggested indistinct disks below each cerarius in undistended adult females; of the usual Pseudococcine type, antennae normally 9-segmented, the range of measurements in microns of those available for study as follows: I, about 36; II, 46–61; III, 46–53; IV, 32–39; V, 29–36; VI, 29–36; VII, 29–32; VIII, 32–36; IX, 54–61; (segments 4 and 5 incompletely separated in one antenna); legs not unusual, hind coxae without pores, measurement of a middle leg in microns as follows: coxa 125, trochanter 79, femur 186, tibia 190, tarsus 89, claw 29; claw with a distinctly developed denticle about one-third of length from apex, digitules slender, those of claw knobbed, those of tarsus acute at apices; beak elongate, triangular, more or less distinctly 2-segmented, length about 114 μ; with the usual anterior and posterior pairs of slit-like dorsal ostioles; with eighteen pairs of cerarii along the body margin, each of these composed of two slender lanceolate spines and a few (3 to 9) triangular pores, and each underlaid, in newly emerged and undistended adult females only, by a fairly distinct, but only slightly chitinized, circular to oval disk; rarely with one or two smaller dorsal spines approximating the cerarian area so closely as to appear to be a part of the cerarius, average length of cerarian spines 11 μ, spines of apical cerarii about 17 μ long, correspondingly larger than the others on the body and accompanied by more triangular pores than any other cerarii; apical setae of anal lobes about 196 μ long; without ventral chitinized thickenings on anal lobes, but with several setae of various sizes ventrally just anterior to the apical setae; anal ring bearing six setae averaging about 107 μ in length and each half composed of an inner scalloped band of irregularly shaped larger pores and an outer band of nearly uniformly rounded, smaller, but less heavily chitinized, pores; dorsally, at least in the abdominal region, with transverse segmental rows of scattered triangular pores and slender lanceolate spines, the former much more abundant than the latter; with tubular ducts of moderate size surrounding the cerarii dorsally and ventrally at the body margin and extending in transverse segmental bands of scattered ducts across the ventral abdominal segments; with five transverse segmental rows of scattered large circular disk pores ventrally in the abdominal region; also ventrally with transverse segmental single rows of setae of different sizes; with a single, transversely oval to quadrate, cicatrix.

No other stages of this species have been available for examination.

This species has been described from four mounted specimens collected "on bush near shore, Tover, Apr. 28" (Invert. no. 2413).

The types are in the U. S. National Collection of Coccidae.

The present state of the classification of *Phenacoccus* and related genera is such that the writer can make no precise suggestions regarding the relationships of the species described above. Its structural characters appear to be quite commonplace, leaving its comparatively small size the most evident feature of the species.

Pseudococcus galapagoensis sp. nov.

Adult Female.—Only alcoholic specimens available for examination, so nothing regarding the external appearance can be given; length 3.5 mm., width 2 mm.; elongate oval, apices tending to be pointed; antennae normally

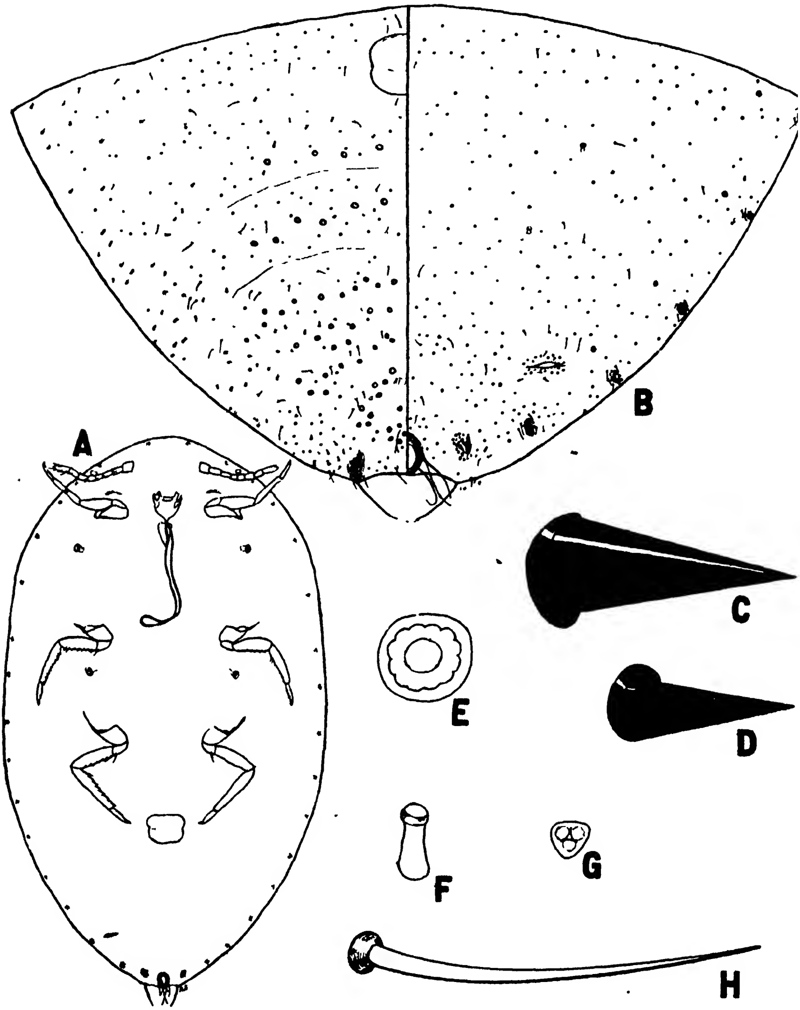


FIG. 36. *PSEUDOCOCCUS GALAPAGOENSIS*, sp. nov.

A, outline of body, optical section, × 21; B, posterior apex of abdomen, dorsal and ventral, × 60; C, apical cerarian spine, × 1500; D, penultimate cerarian spine, × 1500; E, multilocular disk pore, × 1500; F, small tubular duct, × 1500; G, triangular pore, × 1500; H, body seta, × 1500; all adult female.

8-segmented, lengths of segments in microns as follows: I, 64; II, 78; III, 68; IV, 43–46; V, 46–57; VI, 39–43; VII, 39; VIII, 93–96; legs not unusual, lengths of parts of middle leg in microns as follows: coxa 196, trochanter 107, femur 268, tibia 278, tarsus 103, claw 36; claw without denticle, both tarsal and claw

digitules slightly knobbed at apices, those of claw distinctly stouter near base, hind coxa without distinctly developed, enlarged pores, although both coxa and femur with some such enlarged pores or aerolations faintly suggested; beak elongate triangular, distinctly 2-segmented, length 171 μ, width at base 114 μ; with the usual two pairs of dorsal ostioles, the anterior pair relatively inconspicuous; with 17 pairs of cerarii, the typical arrangement of each consisting of two spines surrounded by a cluster of pores and, at outer margin of this, 4 setae, this arrangement varying however, as few as three pores and one seta being present; spines of posterior cerarii distinctly larger and stouter than any of the others, the size of these gradually reduced anteriorly; a tabulation of the cerarian spines showing the following count: I (anterior), 3; II, 2; III, 2–3; IV, 1–2; V, 2; VI, 2–3; VII to XVII inclusive, 2 each; pores in the anal lobe cerarii fairly closely crowded, those in the other cerarii more scattered; apical seta of anal lobes about 121 μ long, ventral surface of anal lobes with a small, not very distinctly chitinized, thickening; anal ring with the usual inner and outer rows of pores and with six setae, these averaging about 130 μ in length; derm dorsally, at least in the abdominal region, with triangular pores and some small setae, and, on some abdominal segments, with an enlarged tubular duct just within each cerarius and another similar duct about half way between the center line and each of the submarginal ducts; ventrally with larger setae and large multilocular disk pores in definite transverse rows in the abdominal region, clusters of small short tubular ducts around and between the cerarii, mostly on the ventral surface, and similar ducts and triangular pores scattered over the mid-ventral area; the single ventral cicatrix quite large and more or less distinctly quadrate with rounded corners.

This species has been described from a single mounted specimen having the following data: "from roots of a yellow-plumed ground plant, Eden Island, N.W. coast of Indefatigable, April 8" (Invert. no. 2204).

The type is in the U. S. National Collection of Coccidae.

Pseudococcus insularis sp. nov.

Adult Female.—Only alcoholic specimens available for examination, so nothing regarding normal external appearances can be given; length as mounted on slide 3.4 mm., width 1.9 mm.; body elongate oval, tapering somewhat posteriorly; antennae of the normal Pseudococcine type, 8-segmented, measurements in microns of the segments available for study as follows: I, 64–68; II, 89; III, 86–89; IV, 57; V, 57–64; VI, 50; VII, 46; VIII, 107; legs of the usual Pseudococcine type, hind coxae without pores, length in microns of a middle leg as follows: coxa about 160, trochanter 125, femur 300, tibia 300, tarsus 107, claw 36; claw without denticle, claw digitules fairly distinctly knobbed at apices, tarsal digitules very slightly knobbed; beak fairly stout-conical, indistinctly 2-segmented; with the usual anterior and posterior pairs of slit-like dorsal ostioles; differing from the normal Pseudococcus type in the possession of only fifteen pairs of cerarii, each of these composed of triangular pores, accessory setae and spines, the latter running as follows in the cerarii examined: I, 3; II, 3; III, 3; IV, 2; V, 2; VI, 2–3; VII–XV, 2 each; number of accessory setae varying from 1 to 4 in the anterior and lateral cerarii, increasing to 5 in the

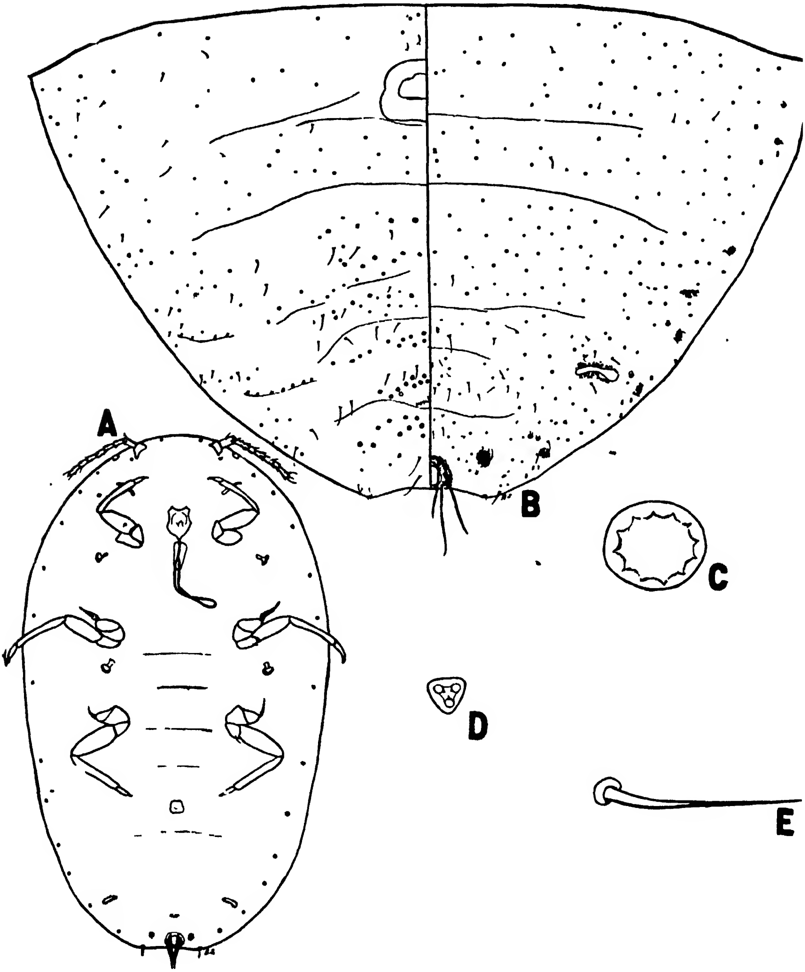


FIG. 37. *PSEUDOCOCCUS INSULARIS*, sp. nov.

A, outline of body, optical section, × 21; B, apex of abdomen, dorsal and ventral, × 60; C, multilocular disk pore, × 1500; D, triangular pore, × 1500; E, body seta, × 1500; all adult female.

anal lobe cerarii; spines of anal lobe cerarii conspicuously larger than any of the others, those of the preapical cerarii intermediate in size, the remaining cerarian spines much smaller and more slender; triangular pores of apical cerarii closely crowded to form a dense oval cluster surrounding the spines, those of the remaining cerarii distinctly but not widely separated from one another; apical setae of anal lobes broken, but probably, from diameter of socket, longer than

those of anal ring; anal ring setae about 160 μ long; no ventral chitinous thickenings on the anal lobes; dorsally, at least in the abdominal region, with transverse segmental rows of widely scattered slender setae and much more numerous but scattered segmental bands of triangular pores, also, at least on some segments, with one or two median and one or two submarginal dorsal enlarged tubular ducts; ventrally, at least in the abdominal region, with seven transverse rows or clusters of large circular disk pores, with indistinct clusters of widely separated small tubular ducts beneath each cerarius and with more or less distinctly developed, transverse rows of widely scattered triangular pores, smaller tubular ducts and slender setae; anal ring rather narrow, with six setae and the usual inner and a single outer row of pores; ventral cicatrix large, more or less distinctly quadrate, with rounded corners, somewhat constricted transversely about the middle.

This species has been described from a single mounted specimen collected "under stone near brackish water pool, South Seymour, Apr. 20" (Invert. no. 2272).

The holotype is in the U. S. National Collection of Coccidae.

The insect above described rather closely resembles the preceding species, differing, however, in presumably important characteristics, in that it has only 15 pairs of definitely developed cerarii and has no visible ventral chitinized thickening on the anal lobes. There are also apparent differences in the relative and actual numbers of the various types of pores present but the constancy of such differences has not thus far been established.

Subfamily Coccinae

Ceroplastes sp.

Two lots of specimens of a species of *Ceroplastes* were included with the material examined. The outer waxy covering of a few of the specimens was in fairly good condition, but only fragmentary portions of the female body could be obtained for study purposes. While the species does not appear to agree with any of the described forms with which the writer is familiar and is quite probably undescribed, the material available does not permit the preparation of an adequate and satisfactory description.

The following data accompanied the two lots of material: "from bag of earth and leaves taken from under *Maytena* bushes on Eden Island, N.W. of Indefatigable, Apr. 8, 1923" (Invert. no. 2183) and "Under lava, Seymour Bay, Indefatigable, April 25" (Invert. no. 2552).

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

BRACHYURAN CRABS
COLLECTED BY THE WILLIAMS GALAPAGOS EXPEDITION, 1923

BY MARY J. RATHBUN
Division of Marine Invertebrates, U. S. National Museum, Washington, D. C.

(Plate VII. Fig. 38)

The collection numbers 23 species, 12 of these being from the Galapagos and the remainder from the Atlantic side of Panama and the vicinity of Key West.

There are several interesting occurrences. Two very small crabs are referable to *Xanthias insculpta*, a species not reported since the type from Lower California was described by Stimpson. The author had in hand but one individual, which is no longer extant, having probably been destroyed with extensive collections by the Chicago fire of 1871.

The grey box crab, *Calappa convexa*, had not up to this time been taken at the Galapagos. Its occurrence there was to be expected, as the crustacean fauna of the archipelago is in great part identical with that of the adjacent mainland.

Colon is a new locality for the seemingly rare fiddler crab, *Uca heterochelos*, although this is not an extension of its range.

It is a satisfaction to report a new form of megalops, referable probably to the Galapagos sand crab, thus adding another bit of knowledge to that little known subject, the development of the crab from the egg to the mature crab form.

Mithrax bellii Gerstaecker. (Moss-back Crab).

> *Mithrax ursus* Bell, *Proc. Zool. Soc. London*, *vol.* 3, 1835 (1836), *p.* 171 (not *Cancer ursus* Herbst, 1788); *Trans. Zool. Soc. London*, *vol.* 2, 1836, *p.* 52, *pl.* 10, *figs.* 2, 2c, 2d, 2e *and* 3.
>
> *Mithrax bellii* Gerstaecker, *Arch. f. Naturg.*, *vol.* 22, *part* 1, 1856, *p.* 112.

Eden Island, Galapagos Islands, in rock pools, April 6; 1 young male, with carapace 11.7 mm. long, 10.3 wide. The young of this species are almost concealed by a dense mosslike covering of setae, which largely disappears with age; the carapace also grows broader until its breadth exceeds the length. The young have only five marginal spines.

Range.—Galapagos Islands; Chile.

First form on press April 28, 1924.

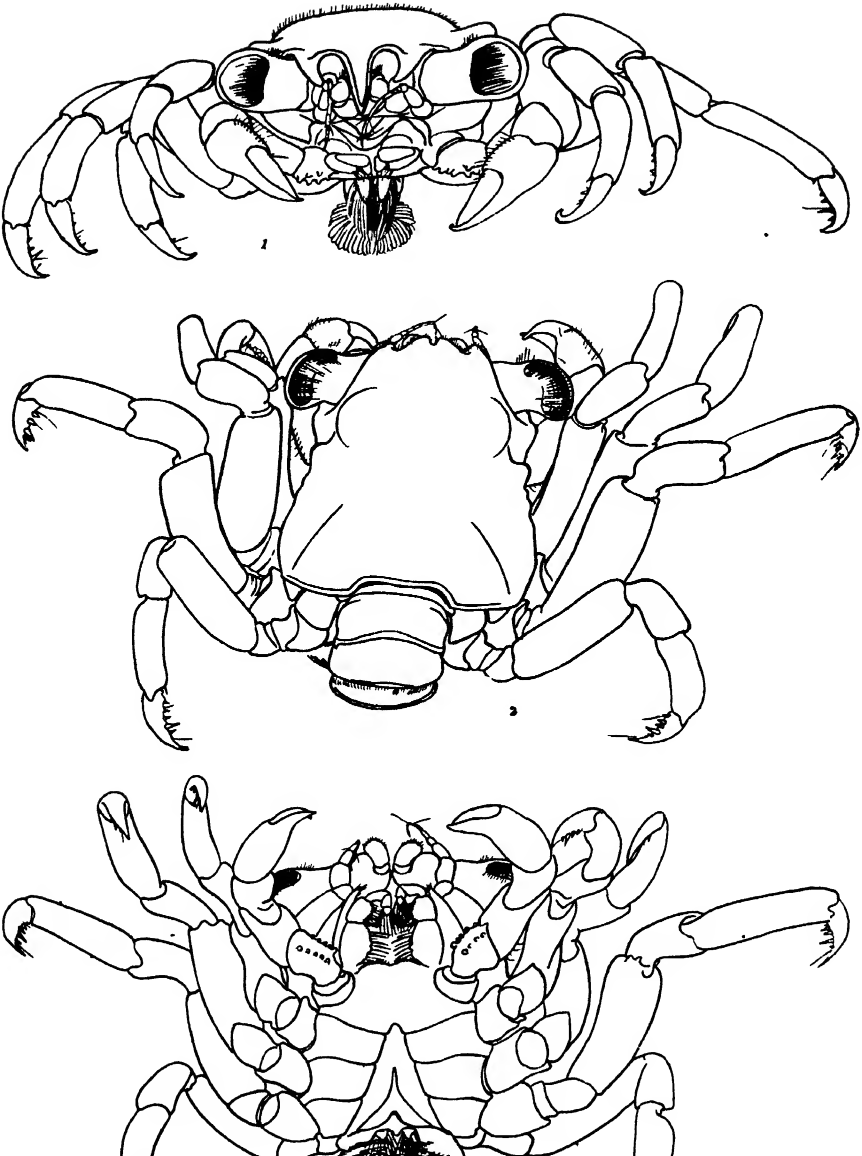


PLATE VII. MEGALOPS OF (?) *OCYPODE GAUDICHAUDII*.
From surface of a puffer in a pool at Eden Island. Carapace 4.6 mm. long. 1, front view; 2, dorsal view; 3, ventral view. Drawn by C. J. Fish.

Ocypode albicans Bosc. (Ghost Crab or Sand Crab).

Ocypoda albicans Bosc, *Hist. Nat. Crust., vol.* 1, *an X* (1801-1802), *p.* 196, *not pl.* 4, *fig.* 1.

Ocypode arenarius Say, *Journ. Acad. Nat. Sci. Philadelphia, vol.* 1, 1817, *p.* 69.

Ocypode albicans Rathbun, *Bull.* 97, *U. S. Nat. Mus.*, 1918, *p.* 367, *pls.* 127 *and* 128.

Colon, Panama; 2 males (1 young).

This is the common sand crab of the eastern coast of America, ranging from Block Island to Brazil.

Ocypode gaudichaudii Milne Edwards and Lucas.

Ocypode gaudichaudii Milne Edwards and Lucas, *d'Orbigny's Voyage dans l'Amér. Mérid., vol.* 6, 1843, *Crust., p.* 26; *vol.* 9, *atlas*, 1847, *pl.* 11, *figs.* 4-4*b*.

(Plate VII, figs. 1-3).

A small crab was taken from the surface of a puffer, *Spheroides annulatus*, in a pool at Eden Island. It proved to be a megalops, or one of the later developmental stages of a crab; it is similar to a known megalops of *Ocypode albicans*, and for that reason I have ventured to give it the name of the only sand crab occurring at the Galapagos, viz.: *O. gaudichaudii*. In the adult of this species the eyes are remarkable in having a slender style projecting from them; this style may be as long as the eye and its stalk.

The carapace of the megalops is 4.6 mm. long, 4 mm. wide. Its sides are high and are crossed obliquely by three furrows into which as many ambulatories may fit; between the first (or anterior) and the second groove, there is a prominent, rectangular, hepatic tubercle; on the branchial region on the posterior margin of the second groove there is a sharp oblique ridge. The mesogastric and cardiac regions are each set off by deep grooves; the mesogastric is partially divided into three parts. The front is deeply cut into three narrow, deflexed lobes, of which the lateral are only half as long as the median lobe. A deep median groove extends forward from the gastric region. The body is covered with pigment spots which are larger anteriorly and diminish in size and number posteriorly, being very few on the sixth abdominal somite and absent from the telson. The raised portions of the carapace are covered with a short pubescence, while a transverse line of hairs crosses the branchial and anterior cardiac regions. The posterior border of the first six abdominal somites is fringed with short hair, and of the pleopods with long hair.

The ambulatories are sparingly dotted with fine pigment spots which thin out distally, being absent from the dactyls and upper half of the propodites. Five spines below each dactyl, the second spine from the tip being the longest. No hairs between bases of second and third ambulatories.

Uca galapagensis Rathbun. (Broad-fronted Fiddler Crab).

Uca galapagensis Rathbun, *Proc. Washington Acad. Sci., vol.* 4, 1902, *p.* 275, *pl.* 12, *figs.* 1 *and* 2; *Bull.* 97, *U. S. Nat. Mus.*, 1918, *p.* 403, *pl.* 142, *text-fig.* 167.

James Island, common about salt ponds, April 4; 3 males, 1 female, all very small.

South Seymour Island, April 21, 1 male from a salt pool, 1 female from the beach.

Indefatigable Island, April 25; 1 male.

Eden Island; 1 male.

This is the larger of the two fiddlers that inhabit the Galapagos.

Uca heterochelos (Lamarck). (Narrow-fronted Fiddler Crab).

> *Ocypoda heterochelos* Lamarck, *Syst. Anim. sans Vert.*, 1801, *p.* 150.
> *Gelasimus heterocheles*, Kingsley, *Proc. Acad. Nat. Sci. Philadelphia*, 1880, *p.* 137, *pl.* 9, *fig.* 2 *(part)*.
> *Uca heterochelos* Rathbun, *Bull.* 97, *U. S. Nat. Mus.*, 1918 *p.* 381, *pl.* 131, *figs.* 1 *and* 2.

Colon; 1 male, half grown.

This is one of the groups of fiddlers in which the front between the eyes is very narrow, tongue-like. While the species ranges from the Bahamas to Brazil, it has not before been noted from Panama.

Cardisoma guanhumi Latreille. (Large Land Crab).

> *Cardisoma guanhumi* Latreille, *Encyc. Méth., Hist. Nat., Entom., vol.* 10, 1825, *p.* 685. Rathbun, *Bull.* 97, *U. S. Nat. Mus.*, 1918, *p.* 341, *pls.* 106 *and* 107, *text-fig.* 155.

Colon; 1 male. Found in great numbers, all having the same light blue color. Widely distributed on the Atlantic coast of America, from Bahamas to Brazil.

Gecarcinus lateralis (Freminville). (Small Land Crab).

> *Ocypoda lateralis* Freminville, *Ann. Sci. Nat., ser.* 2, *Zool., vol.* 3, 1835, *p* 224.
> *Gecarcinus lateralis* Guérin, *Icon. Règne Anim., pl.* 5, *fig* .1. Rathbun, *Bull.* 97, *U. S. Nat. Mus.*, 1918, *p.* 355, *pls.* 119 *and* 120, *text-fig.* 161.

Colon; 1 female. This species is considerably smaller than the *Cardisoma* and is always of a deeper, richer color. It ranges on the Atlantic coast from the Bahamas to Guiana.

Grapsus grapsus (Linnaeus). (Rock Crab).

> *Cancer grapsus* Linnaeus, *Syst. Nat., ed.* 10, *vol.* 1, 1758, *p.* 630.
> *Grapsus grapsus* Ives, *Proc. Acad. Nat. Sci. Philadelphia*, 1891, *p.* 190 Rathbun, *Bull* 97, *U.S. Nat. Mus.*, 1918, *p.*227, *pls.*53 *and* 54, *text-fig.* 135

Eden Island, off Indefatigable Island; 1 male, 1 female.

Indefatigable Island; 1 young female.

Common in the tropics on rocky shores on both sides of the American continent.

Geograpsus lividus (Milne Edwards). (Small Rock Crab).

> *Grapsus lividus* Milne Edwards, *Hist. Nat. Crust., vol* 2, 1837, *p.* 85.
> *Geograpsus lividus* Stimpson, *Ann. Lyc. Nat. Hist. New York, vol.* 7, 1860, *p.* 230. Rathbun, *Bull.* 97, *U. S. Nat. Mus.*, 1918, *p.* 232, *pl.* 55.

Tower Island, Galapagos; 1 young.

A smaller, and duller-colored form than the preceding; it has acutely pointed fingers instead of spoon-shaped ones. Found on both sides of the continent.

Goniopsis cruentata (Latreille). (Mangrove Crab).

Grapsus cruentatus Latreille, *Hist. Nat. Crust.*, *vol.* 6, 1803, *p.* 70.
Goniopsis cruentatus Rathbun, *Bull. U. S. Fish. Comm.*, *vol.* 20, *for* 1900, *pt.* 2 (1901), *p.* 15, *pl.* 1 (*colored*); *Bull.* 97, *U. S. Nat. Mus.*, 1918, *p.* 237, *pl.* 57, *text-fig.* 136.

Colon, Panama; 1 young specimen.

This crab can be told by its brilliant coloring in connection with the flashing white outer surface of its palms.

Planes minutus (Linnaeus). (Sargassum Crab).

Cancer minutus Linnaeus. *Syst. Nat.*, *ed.* 10, *vol.* 1, 1758, *p.* 625.
Planes minutus White, *List Crust. Brit. Mus.*, 1847, *p.* 42.

Off eastern Cuba, in *Sargassum*, 13 specimens from four different stations. For variations in this widely distributed species, see Verrill, *Trans. Connecticut Acad. Sci.*, *vol.* 13, 1908, *p.* 325, *pl.* 13.

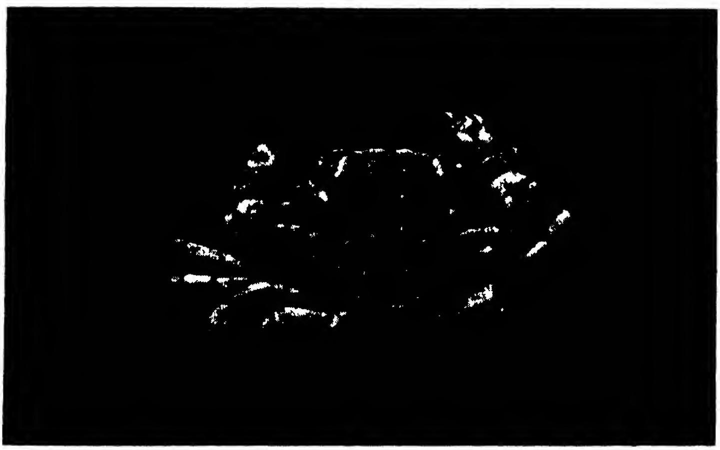


FIG. 38 *XANTHIAS INSCULPTA* STIMPSON.
Immature male, carapace 4 mm. wide. Off Eden Island.

Xanthias insculpta (Stimpson). (Sculptured Crab).

Xanthodes insculpta Stimpson, *Ann. Lyc. Nat. Hist. N. Y.*, *vol.* 10, 1871, *p.* 105.
Xanthias insculptus Rathbun, *Bull. Labor. Nat. Hist. State Univ. Iowa*, *vol.* 4, 1898, *p.* 271.

Off Eden Island, 5 fathoms; 1 immature male, 1 young.

This species was known hitherto only from the type from Cape St. Lucas. The larger of the Galapagos specimens is about the same size as the type. The species probably grows much larger. The gastric and frontal regions are deeply lobulated, the antero-lateral regions and also the dorsal aspect of the wrist and palm are lumpy. There are four equal, small, but well-marked teeth on the antero-lateral margin of the carapace behind the orbital angle, and a

small tooth at the outer end of each of the frontal lobes. There is a longitudinal ridge through the middle of the palm and above it a few obsolescent transverse ranges of minute granules. The dark color of the immovable finger is continued back on the palm for a ways.

Extreme length of carapace 3 mm., width 4 mm.

Xanthodius lobatus (A. Milne Edwards). (Oblong Crab).

> *Leptodius lobatus* A. Milne Edwards, *Crust. Rég. Mex.*, 1880, *p.* 271, *pl.* 49, *fig.* 4.

Eden Island, rock pools; 1 male. Inhabits Clarion Island and Chile as well as the Galapagos.

Menippe nodifrons Stimpson. (Stone Crab).

> *Menippe nodifrons* Stimpson, *Ann. Lyc. Nat Hist. N. Y*, *vol.* 7 1859 *p.* 53 Rathbun, *Bull. U. S. Fish Comm.*, *vol.* 20, *for* 1900, *pl.* 2 (1901), *p.* 37.

A young specimen of this species was taken from the dock piles at Colon Harbor.

Ozius verreauxii Saussure.

> *Ozius verreauxii* Saussure, *Rev. et Mag. de Zool.*, *ser.* 2 *vol.* 5, 1853, *p* 359 *pl* 12, *fig.* 1.

Indefatigable Island, April 25; 1 male.

Is found also on the mainland from Lower California to Ecuador.

Eriphia granulosa A. Milne Edwards.

> *Eriphia granulosa* A. Milne Edwards, *Crust. Rég. Mex.*, 1880, *p.* 339, *pl* 56. *fig.* 2.

Eden Island, rock pools, April 6; 1 young.

This species has been recorded from Chile as well as the Galapagos Islands.

Eriphides hispida (Stimpson). (Red-Bristle Crab).

> *Eriphia hispida* Stimpson, *Ann. Lyc. Nat Hist. N. Y.*, *vol.* 7, 1860, *p* 218.
> *Pseuderiphia hispida* A. Milne Edwards, *Crust. Rég. Mex.*, 1880, *p.* 340, *pl.* 56, *fig.* 1.

Eden Island; 1 female. Known from Central America, Panama and the Galapagos.

Portunus sayi (Gibbes). (Sargassum Crab).

> *Lupa sayi* Gibbes, *Proc. Amer. Assoc. Adv. Sci.*, *vol* 3, 1850, *p.* 178 [14].
> *Neptunus sayi* A. Milne Edwards, *Arch. Mus. Hist. Nat., Paris*, *vol.* 10, 1861, *p.* 317, *pl.* 29, *fig.* 2.

This is the common pelagic swimming crab of the Atlantic; 5 specimens were taken at 3 stations off eastern Cuba, in *Sargassum*.

Callinectes danae Smith. (Brown Swimming Crab).

> *Callinectes danae* Smith, *Trans. Conn. Acad. Sci.*, *vol.* 2, 1869, *p* 7. Rathbun, *Proc. U. S. Nat. Mus.*, *vol.* 18. 1895, *p.* 357, *pl.* 16; 26, *fig.* 4: 25, *fig.* 3; 26, *fig.* 3; 27, *fig.* 3.

Colon; 1 male. Extends from Florida to Brazil. Differs from the common edible or "blue" crab of our coast, by its dull color, four teeth instead of two on its front margin between the antennae, by the greater width of the circumscribed area in the middle of the carapace, and by other less evident characters.

Cronius ruber (Lamarck). (Red Swimming Crab).

Portunus ruber Lamarck, *Hist. Nat. Anim. sans Vert.*, *vol.* 5, 1818, *p.* 260.
Cronius ruber Stimpson, *Ann. Lyc. Nat. Hist. N. Y.*, *vol.* 7, 1860, *p.* 225.
Achelous ruber A. Milne Edwards, *Arch. Mus. Hist. Nat., Paris*, *vol.* 10, 1861, *p.* 345, *pl.* 23, *fig.* 1.

Off Eden Island, 5 fathoms, April 1; 1 young specimen.

This form appears to be indistinguishable on opposite sides of the continent. It ranges from South Carolina to Brazil and from Lower California to Ecuador.

Cronius tumidulus (Stimpson). (Small Swimming Crab).

Achelous tumidulus Stimpson, *Bull. Mus. Comp. Zoöl.*, *vol.* 2, 1871, *p.* 149.
Cronius bispinosus Miers, *Challenger Rept., Zool.*, *vol.* 17, 1886, *p.* 188, *pl.* 15, *fig.* 2.

Off eastern Cuba, in Sargassum; 4 young specimens.

This is not one of the two so-called "Sargassum crabs," but a much more uncommon swimming crab than *Portunus sayi*. *C. tumidulus* has been found sparingly from the Bahamas to Bahia.

Calappa convexa Saussure. (Grey Box Crab).

Calappa convexa Saussure, *Rev. et Mag. de Zool.*, *ser.* 2, *vol.* 4, 1853, *p.* 362, *pl.* 13, *fig.* 3.

Eden Island; 1 male. This is known from Cape St. Lucas to Ecuador.

Calappa flammea (Herbst). (Purple-striped Box Crab).

Cancer flammeus Herbst, *Natur. Krabben u. Krebse*, *vol.* 2, 1794, *p.* 161, *pl.* 40, *fig.* 2; *vol.* 3, *part* 3, 1803, *p.* 19.
Calappa flammea Bosc, *Hist. Nat. Crust.*, *vol.* 1, 1802, *p.* 185. Rathbun, *Bull. U. S. Fish Comm.*, *vol.* 20, *for* 1900, *pt.* 2 (1901), *p.* 84, *pl.* 2.

Key West; 1 male. This is the common box crab of our Atlantic coast, from North Carolina to Brazil.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

THE MACRURA AND ANOMURA
COLLECTED BY THE WILLIAMS GALAPAGOS EXPEDITION, 1923

By Waldo L. Schmitt

Curator of Marine Invertebrates, U. S. National Museum, Washington, D. C.

(Figs. 39–41 incl.)

This collection, though not large in point of numbers, is of great interest in its extension of our knowledge of the carcinological fauna of the Galapagos Islands. In the crustacean collections made by the Hopkins Stanford Galapagos Expedition of 1898–99, and reported on by Dr. Mary J. Rathbun[1] there were five macrurous forms not represented in the present one. On the other hand it gives us five new records for the Islands, two of which, *Hippolyte williamsi* and *Lysmata galapagensis* are apparently undescribed species, in addition to two already known from the Galapagos, but not returned by the Hopkins Expedition. En route three well-known species of Sargassum shrimps were taken at several stations in West Indian waters, and a familiar fresh-water crayfish, or rather shrimp, from the Canal Zone.

Penaeopsis kishinouyei (Rathbun).

> *Parapenaeus kishinouyei* Rathbun, *Proc. Washington, Acad. Sci*., *vol.* 4, 1902, *p.* 288, *pl.* 12, *figs.* 13–15.
> *Penaeopsis kishinouyei* de Man, "*Siboga*" *Exped., Monog.* 39*a*, *Decapoda*, *pl.* 1, *Penaeidae*, 1911, *pp.* 8, 55.

Eden, off Indefatigable Island; dredged in five fathoms, April 1; 2 immature females.

Exopodites are present on all the legs, and epipodites on all but the last two pairs. The meri of the fifth legs of the males of the type lot are not notched, and the telson bears three pairs of lateral marginal spines.

The Eden specimens have respectively nine, and eight rostral teeth, counting the gastric one; the antero-lateral angle of the carapace is spinous.

This species is known only from the Galapagos Islands, "the types were taken at Tagus Cove, on the reef north of Tagus Hill, Albemarle Island," while four other specimens collected about the same time were "taken in 2 fathoms in Tagus Cove."

[1] Proc. Washington Acad. Sci., vol. 4, 1902, pp. 275–292, pl. 12, text-figs. 1-4.

First form on press April 28, 1924.

Crangon bouvieri var. *chilensis* (Coutière).

Alpheus bouvieri var. *chilensis* Coutière, *Lenz, Zool. Jahrb., Suppl. vol.* 5, 1902, *p.* 732.

Eden; rock pools, April 6; 1 specimen.

This species hitherto was known only from the three specimens of the type lot from Calbuco, Chile.

Synalpheus nobilii Coutière.

Synalpheus nobilii Coutière, *Proc. U. S. Nat. Mus., vol.* 36, 1909, *p.* 40, *text-fig.* 22.
? *Synalpheus neptunus* Rathbun, *Proc. Washington Acad Sci., vol* 4, 1902, *p.* 289.

FIG. 39. *SYNALPHEUS NOBILII* COUTIÈRE

a, second leg of right side; *b*, third leg; *c*, dactyl of same, more enlarged.

Eden, rock pools; April 6; 1 specimen.

The large hand of this specimen has much the appearance of that of *S. sanlucasi* Coutière (*op. cit.*, p. 41) with which Miss Rathbun had later identified her material from Albemarle Island. I have been unable to examine those specimens, as they are still in the hands of Prof. Coutière, who is monographing the National Museum Alpheids.

The proportions of the second legs of the specimen before me definitely set it apart from *S. sanlucasi;* and the antennules, antennae, spines, scales, and rostrum have the slender form as in *S. fritzmülleri* and *S. nobilii.* On the basis of the stouter third legs it is identified with the latter rather than the former species.

The only other known specimen of the species is the type in the Paris Museum, from St. Helena, Ecuador.

Hippolyte williamsi sp. nov.[2]

Type Locality.—Eden; rock pools, April 6; 1 ♀ with carapace and rostrum together, but slightly more than 3.5 mm. in length.

Description.—Rostrum reaching four sevenths the length of the antennal scale, exceeding the antennular peduncle by about the length of the first two segments of the thicker flagellum, equalling about three fourths the length of the carapace; above the rostrum has two subequal teeth, the anterior of which is situated just behind the middle of the rostrum, and the first at about the distal third of the interval between the second tooth and the orbital margin; below there are three teeth of which the first is situated just before the distal margin of the first segment of the antennular peduncle, being about as far in advance of the second dorsal as that tooth is in front of the first dorsal, the second ventral is not quite half the distance between the first and third in advance of the former, the last tooth is immediately behind the acute tip, giving it a bifid appearance; on the dorsal margin a little in advance of the first ventral tooth, there is an inconspicuous tiny notch or tooth which might possibly be considered as a third dorsal. The last two joints of the antennular peduncle are subequal; taken together they are shorter than the first joint; antennal peduncle reaching to or just beyond the distal margin of the second antennular segment. Supra-orbital and branchiostegal spines well developed.

Distally, the outer, lateral face of the merus of the third legs is armed with three conspicuous spines, increasing in size from behind forwards, the largest, the anterior spine, is placed lower than the others; fourth leg with two such meral spines, of which the anterior is almost ventral; fifth leg with merus unarmed; carpal joints of last three pairs with a spine on outer face at about one third the length of the joint from the posterior margin; propodus of third leg short and stout, less than three times as long as the dactyl; the dactyls of the last three pairs of legs are quite powerful, stout and well spined, spines terminally quite strong, and set close together; posteriorly, the dactyls are produced, forming a peculiar, unarmed "heel." The third legs fall short of the end of the antennal scale, though they exceed its spine by about the length of the dactyl, the second legs and third maxillipeds reach about as far forward as the distal margin of the first joint of the antennular peduncle.

Fifth abdominal somite about two thirds the length of the sixth, sixth nearly as long as the telson which is slightly shorter than the inner branches of the uropods.

[2] Named in honor of Harrison Williams, Patron and Curator of Ichthyology of the Department of Tropical Research, New York Zoological Society, whose interest and liberality rendered possible the collection of the material upon which this report is based.

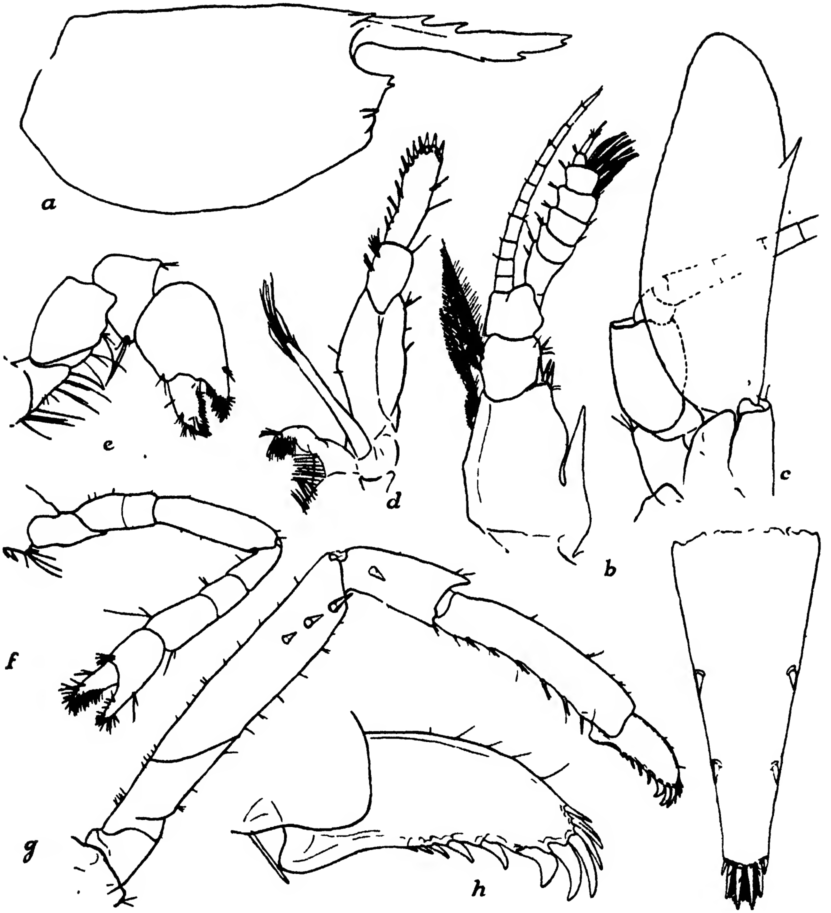


FIG. 40. *HIPPOLYTE WILLIAMSI*, sp. nov.

a, lateral view of carapace; *b*, antennule; *c*, antennal scale; *d*, third maxilliped; *e*, first leg; *f*, second leg; *g*, third leg; *h*, dactyl of same, more enlarged; *i*, telson.

Remarks.—Our species seems to be quite distinct from the other known Hippolytids that may have a similar rostral formula, three teeth below and two or three above. *Hippolyte pleuracantha* (Stimpson)[3] has two to three teeth above and three below, but the legs are much more slender and the dactyls have a different shape, being long and narrow instead of short and broad, they

[3] *Virbius pleuracanthus* Stimpson, Ann. Lyc. Nat. Hist. N. Y., vol. 10, 1871, p. 127. Stimpson described this species as having but one tooth on the inferior margin of the rostrum, as a matter of fact, it has quite uniformly three teeth below.

have slender spines on the ventral margin and lack the "heel" found in *H. williamsi;* the propodus of the third leg of *H. pleuracantha* is about six and one third times as long as its greatest width; in *H. williamsi* it is about four and one half times as long as wide, and the dactyl is armed with short stout spines. In *H. obliqui-manus* Dana[4] from "Rio Janeiro," the dactyl and propodus of the third leg are proportioned as in *H. pleuracantha;* the rostrum has three teeth below if we count the ventral tooth of the bifid tip as figured in with the two described as constituting the armature of the lower margin; above there are four teeth; the rostrum is half again as long as the antennular peduncle. In *H. pleuracantha,* though the rostrum has been generally described as "about half as long as the carapace," "scarcely more than half as long as the acicle," and "reaching to extremity of antennular peduncle," in about half of the specimens I have examined, it is about as long as the scale, exceeding the antennular peduncle by about one half the length of the peduncle. Other than in the possession of a fourth tooth on the upper margin of the rostrum, I can detect but one other feature in Dana's figure of *obliqui-manus,* distinguishing it from *H. pleuracantha.* What might have been intended to represent the branchiostegal spine in the former species is situated on or at the anterior margin of the carapace, while in the latter, the tip of that spine is removed by distance at least half, and usually nearly the length of the spine from the anterior margin. *H. williamsi* has the branchiostegal spine placed so close to the anterior margin of the carapace that in part it extends beyond the margin. Heller's Mediterranean *H. gracilis,*[5] has two to three teeth beneath, and three or four on the upper margin, but of the dorsal teeth, two were described as being "behind the eyes," at least one is on the carapace and the second about over the orbital margin, more or less; the branchiostegal spine is figured as being behind the margin, and the rostrum is about half again as long as the antennular peduncle. *Hippolyte californiensis* Holmes,[6] though it may have as few as three teeth below and the same number above, need not be considered here, because of its vastly different form; the tip of the rostrum is usually trifid, the second joint of the antennular peduncle is two to three times as long as the third and more than twice as long as wide, and the sixth abdominal somite is twice as long as the fifth and longer than the telson.

Lysmata galapagensis sp. nov.

Type Locality.—Northeast of Eden; seven fathoms, dredged, April 6; 56 specimens. The carapace and rostrum of the figured female together are about 6 mm. long.

Description.—Rostrum about four ninths the length of the carapace, as long as, or a little longer than the eyestalks, and reaching the distal margin of the first segment of the antennular peduncle; rostral crest is continued backward onto the anterior third of the carapace; above it is usually armed with five or six, more rarely, seven teeth, of which one, less often two are on the carapace; as in the figured specimen there is always a decided hump between the first and

[4] Crust. U. S. Expl. Exped., pt. 1, 1852, p. 564; atlas, 1855, pl. 36, fig. 3*a–f*.
[5] *Virbius gracilis* Heller, Sitzb. Wiener Akad. Wissen., vol. 45, 1862, p. 397, pl. 1, figs. 19, 20.
[6] Proc. Calif. Acad. Sci., ser. 2, vol. 4, 1895, p. 576, text-figs. 21–26.

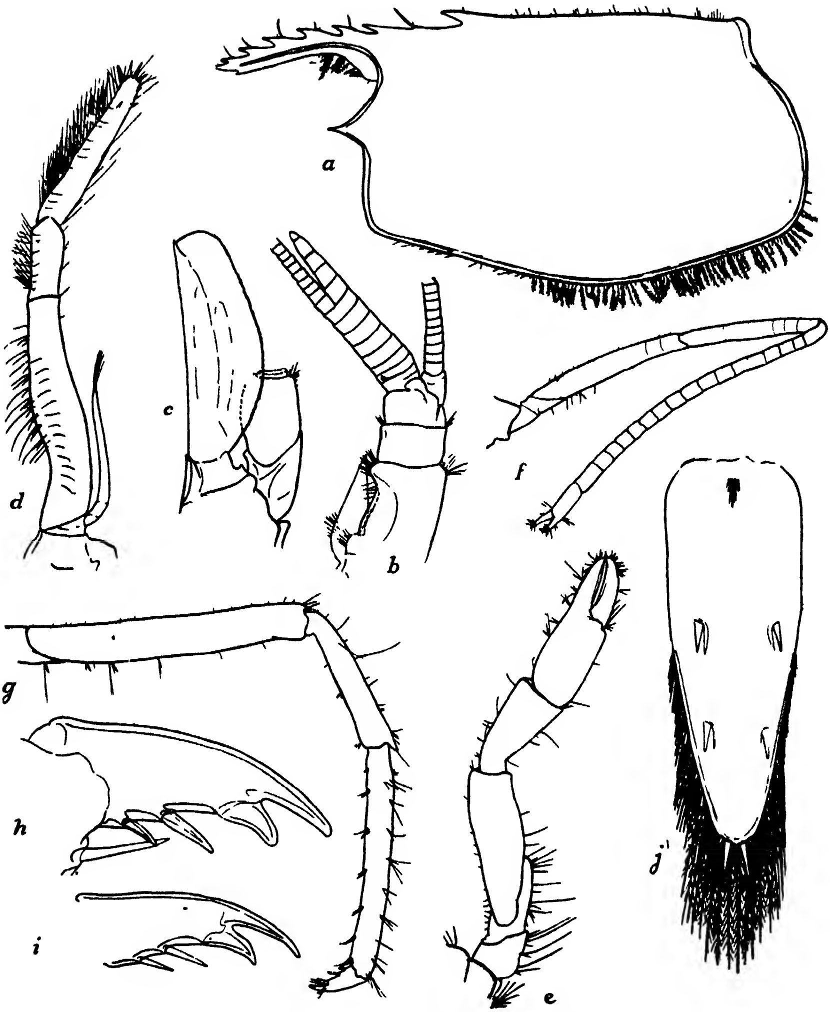


FIG. 41. *LYSMATA GALAPAGENSIS*, sp. nov.

a, lateral view of carapace; *b*, antennule; *c*, antennal scale; *d*, third maxilliped; *e*, first leg; *f*, second leg; *g*, third leg; *h*, dactyl of third leg of another specimen; *i*, dactyl of third specimen; *j*, telson.

second teeth from which arises a conspicuous long hair and maybe one or two smaller ones; similarly hairs occur at about the mid-points of the intervals between the other teeth and the last tooth and the rostral tip as well, but the humps marking their insertion are much less pronounced; the interval between the first and second teeth is as great as between the second and fourth; below

there is sometimes, but not always, a single tiny tooth, close behind the tip of the rostrum, giving it a bifid appearance; posterior dorsal region of carapace with a scattering of short hairs.

The outer antennular flagella are biramus; the free portion of the shorter ramus is composed of three, four or five articles, the fused portion of from six to nine; the second and third articles of the peduncle are subequal and taken together shorter than the basal article; the blade of the antennal scale is broadly rounded and slightly exceeds the spine; mandible without palp or incisor process; third maxillipeds with exopodite, and reaching by nearly half their length beyond the antennal scale; the first legs fall short of antennal scale, the second legs exceed the third maxillipeds and reach about as far forward as the third, exceeding the antennal scale by two thirds of their carpal joints, the third legs extend beyond the scale by the length of the propodus; the carpus of the second legs appears to be divided rather uniformly into seventeen articles, the merus also is annulated, as well as the distal portion of the ischium.

The fifth abdominal somite is not quite three fourths the length of the sixth, and the sixth slightly more than three fourths the length of the telson, the telson is shorter than the uropods.

Remarks.—Kemp has shown in his notes on the "Hippolytidae" of the Indian Museum[7] that *Hippolysmata moorei* Rathbun[8] and *H. intermedia* Kingsley[9] are more properly placed in the genus *Lysmata* on the basis of the bifurcate, outer antennular flagellum. Kemp remarks (*loc. cit.*): "The only difference between this genus and Risso's *Lysmata* is that in the latter the outer antennular flagellum is split and is composed of two unequal rami which are fused basally. In *Hippolysmata* the flagellum is simple. The character does not seem a very important one, but in my experience is reliable; it is, however, not improbable that further investigation will reveal such a degree of gradation that two distinct genera can no longer be recognized, and in this case all the species must take rank under *Lysmata.*"

By the same token *Hippolysmata acicula* and *paucidens* Rathbun[10] from Hawaii also must be considered as belonging to *Lysmata.*

In rostral formula and number of carpal articles, our species seems not unlike Miss Rathbun's *Lysmata moorei* from Porto Rico. The rostrum of the latter, however, is always longer than the eyes, exceeding them by about one half the length of its free portion, reaching at least to the middle of the second segment of the antennular peduncle; usually it is armed with two teeth below, and above with not more than five, the shorter branch of the bifurcate antennular flagellum is composed of twelve free segments and seven to nine fused ones, the free portion being the longer. Our species has the free portion the shorter or at most subequal with the fused portion. Further, in *L. moorei* the antennal scale is more truncate, the fifth abdominal somite is two thirds the length of the sixth, and the sixth four sevenths the length of the telson.

Hippolysmata porteri Rathbun[11] is a true *Hippolysmata.*

[7] Rec. Indian Mus., vol. 10, pt. 2, no. 4, 1914, p. 112

[8] Bull. U. S. Fish. Comm., vol. 20, pt. 2, 1900 (1901), p. 115, text-fig. 23.

[9] Proc. Acad. Nat. Sci. Phila., vol. 30, 1878, p. (2); Bull. Essex Inst., vol. 14, 1882, pl. 28, pl. 1, fig. 4.

[10] Bull. U. S. Fish Comm., vol. 23, pt. 3, 1903 (1906), pp. 912, 913, pl. 34, figs. 4, 6.

[11] Revista Chilena Hist. Nat., vol. 11, 1907, p. 49, pl. 3, fig. 4.

Latreutes fucorum (Fabricius). (Gulf-weed or Sargassum Shrimp).

> *Palaemon fucorum* Fabricius, *Suppl. Entom. Syst.*, 1798, *p.* 404.
> *Latreutes ensiferus* Stimpson, *Proc. Acad. Nat. Sci. Phila.*, *vol.* 12, 1860, *p.* 27. *Bate, Rept. Zool. Voy. "Challenger," vol.* 24, 1888, *p.* 583, *pl.* 104, *figs.* 1–1*g*. *Rathbun, Bull. U. S. Fish Comm., vol.* 20, *pt.* 2, 1900 (1901), *p.* 114.
> *Latreutes fùcorum* Stebbing, *Trans. Roy. Soc. Edinburgh, vol.* 50, *pt.* 2, 1914, *p.* 290, *and synonymy*. *Verrill, Trans. Conn. Acad., vol.* 26, 1922, *p.* 131, *pl.* 16, *figs.* 5–5*b*, *pl.* 42, *figs.* 2–2*t*, *pl.* 44, *figs.* 1–1*m*, 2–2*n*, 3, *and synonymy*.

Off Florida; from *Sargassum;* 8 specimens (2 ovigerous).

Off Cuba; from field of *Sargassum;* 23 specimens (17 ovigerous; 3 with parasitic isopod, *Bopyrina latreuticola* (Gissler)[13] in branchial cavity).

Locality?; 2 specimens (1 ovigerous; 1 with branchial parasite, *Bopyrina latreuticola* (Gissler)).

Verrill remarks:

"This delicate species is common in floating masses of 'gulf-weed' (*Sargassum*). It is abundant as far north as Vineyard Sound, Mass. (S. I. Smith). Very common in the Gulf Stream further south.

Bermuda (coll. G. Brown Goode). Near the Azores (Milne Edwards); African Coast (Krauss); Porto Rico (Rathbun); Beaufort, N. C. (Hay & Shore). It has been taken at Bermuda by nearly all collectors. It is nearly always associated with *Leander* [*Palaemon*] *tenuicornis* and the small crab, *Planes minutus*."

Palaemon tenuicornis Say. (Common Gulf-weed or Sargassum Shrimp).

> *Palaemon tenuicornis* Say, *Jour. Acad. Nat. Sci. Phila.*, *vol.* 1, 1818, *p.* 249.
> *Leander tenuicornis* Stebbing, *Trans. Roy. Soc. Edinburgh, vol.* 50, *pt.* 2, 1914, *p.* 288, *and synonymy*. *Verrill, Trans. Conn. Acad., vol.* 26, 1922, *p.* 143, *pl.* 43, *figs.* 4, 4*a*, *and synonymy*.

Off Cuba; from field of *Sargassum;* 25 specimens (1 ovigerous).

This species is very common among Gulf-weed (*Sargassum*) and is very widely distributed in the tropical Atlantic Ocean (Verrill).

Palaemon ritteri Holmes.

> *Palaemon ritteri* Holmes, *Proc. Calif. Acad. Sci., ser.* 2, *vol.* 4, 1895, *p* 579, *pl.* 21, *figs.* 29–35. *Rathbun, Harriman Alaska Exped., vol.* 10, 1904, *p.* 29.
> *Palaemon* sp. Rathbun, *Proc. Washington Acad. Sci., vol.* 4, 1902, *p.* 291.
> ?*Palaemon ritteri* Rathbun, *Proc. U. S. Nat. Mus., vol.* 38, 1910, *p.* 561.

South Seymour; shore pool, March 28; 1 juvenile.

Tower Island; 1 specimen.

Eden; rock pools, April 6; 1 juvenile. Northeast of Eden; seven fathoms, dredged, April 6; 1 ♀ ovigerous.

The color of the juvenile specimen from a shore pool on South Seymour is given as "almost transparent in life, with numerous black lines, and with legs brilliant scarlet at the joints."

Miss Rathbun's *Palaemon* from Clipperton Island surely is this species in spite of the somewhat different rostrum, longer sixth abdominal segment and blacker eyes. The rostrum looks a little abnormal as though possibly one or

[13] *Bopyroides latreuticola*, Amer. Nat., vol. 16, p. 591, text-figs. 6–8. *Bopyrina latreuticola* Stebbing, Trans. Roy. Soc. Edinburgh, vol. 50, pt. 2, 1914, p. 301.

two of the most anterior teeth were wanting, either through malformation or accident, making the toothless part of the rostrum appear longer and more ascending than usual in this species; a count of the rostral teeth gives seven above of which two are on the carapace, and three below; the last dorsal tooth is a little behind the level of the median ventral one. The shorter ramus of the bifurcate antennular flagellum has eighteen free segments, and six fused, virtually in agreement with the count of typical specimens from Magdalena Bay; in these latter there are sixteen to seventeen free segments and six fused ones. The longer sixth abdomen somite might be an extreme variation, and the blacker eyes due to the preservation.

The Peruvian specimen which Miss Rathbun with some hesitation identified with this species, has the shorter ramus of the bifurcate antennular flagellum composed of twenty free and six fused segments, the carpus of the second legs is as long as the palm and half the length of the fingers together, the fingers are almost as long as the palm, and the fifth abdominal somite is contained one and two thirds times in the length of the sixth.

The species ranges from San Diego, California, (type locality) to Peru (Rathbun).

Macrobrachium jamaicense (Herbst). (Fresh-water Shrimp or Crayfish).

Cancer (Astacus) jamaicensis Herbst, *Naturg. d. Krabben u. Krebse, vol.* 2, 1792, *p.* 57, *pl.* 27, *fig.* 2.
Palaemon jamaicensis Ortmann, *Zool. Jahrb., vol.* 5, 1891, *p.* 729, *pl.* 47, *fig.* 7. *Rev. Mus. Paulista, vol.* 2, 1897, *p.* 208. *Moreira, Archiv. Mus. Nac. Rio de Janeiro, vol.* 11, 1901, *p.* 13, 78.
Bithynis jamaicensis Rathbun, *Bull. U. S. Fish Comm., vol.* 20, *pt.* 2, 1900, (1901), *p.* 123.
Macrobrachium jamaicense Rathbun, *Proc. U. S. Nat. Mus., vol.* 38, 1910 *p.* 561, *pl.* 51, *fig.* 1.

Colon; 1 ♂, 1 ♀.

Gatun spillway, Colon; 1 juvenile.

The juvenile specimen from the Gatun spillway is very probably this species. It is almost impossible to distinguish the young from those of *Macrobrachium olfersii* (Wiegmann).[13]

Miss Rathbun (1910) gives the distribution of this species as, "Fresh waters of Pacific slope of America from Lower California to Peru and of Atlantic slope, from Texas to Brazil, including West Indies."

Urocaris longicaudata (Stimpson).

Urocaris longicaudata Stimpson, *Proc. Acad. Nat. Sci. Phila., vol.* 12, 1860, *p.* 39 [108]. *Kingsley, Proc. Acad. Nat. Sci. Phila., vol.* 31, 1879 (1880), *p.* 424. *Rathbun, Proc. Washington Acad. Sci., vol.* 11, 1900, *p.* 155. *Hay and Shore, Bull. U. S. Bur. Fisheries, vol.* 35, 1918, *p.* 395, *pl.* 27, *fig.* 7.

Off Cuba; from *Sargassum;* 1 ♀ ovigerous.

This species is not infrequent, though never taken in large numbers[14] in the area bounded by Beaufort, N. C., and the Bahamas on the North, Porto Rico and Culebra on the East and with Jacuma, Parahyba, Brazil as its southern limit.

[13] Arch. f. Naturg., vol. 2, pt. 1, 1836, p. 150. =*Palaemon spinimanus* von Martens, Arch. f. Naturg., vol. 35, pt. 1, 1869, p. 26, pl. 2, fig. 3.

[14] The U. S. National Museum possesses, in all, nineteen lots of this species, but two from Florida and one from the Bahamas contain fourteen or more specimens, two lots have four specimens, two, two specimens, and the rest one each.

Petrolisthes edwardsii (Saussure). (Scarlet Tissue Crab).

> *Porcellana edwardsii* Saussure, *Rev. et Mag. de Zool., ser.* 2, *vol.* 5, 1853, *p.* 366, *pl.* 12.
> *Petrolisthes edwardsii* Nobili, *Bull. Mus. Torino, vol.* 16, *no.* 415, 1901, *p.* 11. *Rathbun, Proc. U. S. Nat. Mus., vol.* 38, 1910, *p.* 600.

Eden; rock pools, April 6; 6 specimens.

Ranges from the Gulf of California to Ecuador.

Calcinus obscurus (Stimpson).

> *Calcinus obscurus* Stimpson, *Ann. Lyc. Nat. Hist. N. Y., vol.* 7, 1859, *p.* 83. *Rathbun, Proc. U. S. Nat. Mus., vol.* 38, 1910, *p.* 596. *Nobili, Bull. Mus. Torino, vol. 16, no.* 415, 1901, *p.* 26.

Eden, off Indefatigable Island; 6 specimens.

These specimens are much darker colored than others of the same species from farther north. The dactyls are all double banded, one near the tip and one at the base of the joint; in alcohol, the general coloration of the extremities is a dark, purplish red-brown with white or bluish maculations, the carapace, proximal third of the legs and eyestalks are quite a red brown; where the ground color is lighter, the spots or maculations appear more or less yellowish. A specimen from Chatham Island in the United States National Museum collections shows the coloration noted in this Eden material. Published records seem to indicate that this species ranges from Lower California to Ecuador.

Coenobita clypeatus (Herbst).

> *Cancer clypeatus* Herbst, *Naturg. d. Krabben u. Krebse, vol.* 2, 1791, *p.* 22, *pl.* 23, *figs. A, B.*
> *Coenobita diogenes* Benedict, *Bull. U. S. Fish Comm., vol.* 20, *pt.* 2, 1900 (1901), *p.* 139. *Verrill, Trans. Conn. Acad., vol.* 13, 1908, *p.* 438, *text-fig.* 55, *and synonymy.*
> *Coenobita clypeatus* Rathbun, *Rapport van de Visscherij en de Industrie van zeeproducten in de Kolonie Curacao, uitgebracht door Prof. Dr. J. Boeke, pt.* 2, 1920, *p.* 327 [11], *and synonymy.*

Colon; 3 ♀.

A common West Indian species ranging from Florida to Brazil; also at Bermuda.

Coenobita compressus (Guérin).

> *Coenobita compressa* Guérin, *Voy. autour du Monde sur la Coquille par Duperrey, Zool., vol. 2, pt.* 2, 1831, *p.* 29.
> *Coenobita compressus* Faxon, *Mem. Mus. Comp. Zoöl.. vol.* 18, 1895, *p.* 52. *Rathbun, Proc. U. S. Nat. Mus., vol.* 38, 1910, *p.* 596.

James Island; 1 ♂, 1 ♀.

Miss Rathbun gives the distribution of this species as, "Lower California to Payta, Peru; Galapagos Islands; westward to East Africa."

Hippa denticulatifrons (Miers).

> *Remipes testudinarius*, var. *denticulatifrons* Miers, *Jour. Linn. Soc. London, vol.* 14, 1878, *p.* 318, *pl.* 5, *fig.* 2. *Balss. Abh. der K. Bayer. Akad. Wissen., vol.* 2, *Math.-phys. Klasse Suppl., Abh.* 10, 1914 *p.* 92, *text-fig.* 50.
> *Remipes adactylus denticulatifrons* Ortmann, *Zool. Jahrb. Syst., vol.* 9, 1896, *p.* 229, *and synonymy.*
> *Hippa denticulatifrons* Rathbun, *Proc. U. S. Nat. Mus., vol.* 38, 1910, *p.* 595.

Conway Bay, Indefatigable Island; March 28; 1 ♂.

Northeast of Eden; 7 fathoms, dredged, April 6; 1 ♂.

This species is known from the Galapagos Islands and the Indo-Pacific region as far north as Japan.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Soc ety. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

HYMENOPTERA
COLLECTED BY THE WILLIAMS GALAPAGOS EXPEDITION

By S. A. Rohwer

Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C.

The Hymenoptera listed below were forwarded to me by Dr. William Beebe for identification. They were collected in the Galapagos Islands, in April, 1923, in an expedition sent out by the New York Zoological Society. One of the species had been given a manuscript name by the late Dr. Ashmead from specimens collected in 1899. The series to which Ashmead had assigned the manuscript name is used as types for the new species and the material forwarded by Dr. Beebe are considered paratypes.

Xylocopa colona Lepeletier

Twenty-two specimens which agree very well with the description of this species and also agree perfectly with specimens in the National Collection which were collected in the Galapagos Islands in 1899 and later forwarded to the British Museum, where they were compared by the late Dr. David Sharp with specimens of this species in the collections of the British Museum. Ducke[1] considers that *colona* Lepeletier is a variety of *aurulenta* Fabricius. For the purpose of this report I have preferred not to enter into the validity of this name. The above-mentioned 22 specimens were collected at the following localities: South Seymour, April 23, 1923; at Tagus Cove, Albemarle, April 6, 1923; at Conway Bay, Indefatigable, April 1, 1923.

Tachysphex galapagensis sp. nov.

In general appearance and habitus this species resembles many of the Nearctic forms, but the color of the abdomen is strikingly characteristic inasmuch as the venter is entirely pale and the dor um pale on the apices of the tergites only.

Female.—Length, 8 mm. Clypeus shining, convex, the anterior margin depressed and very gently rounded, without lateral teeth frons coriaceous, distinct impressed line from the anterior ocellus to between the bases of the antennae; interocellar area parted by a longitudinal depression; vertex with distin t, well separated punctures; superior interocular line less than half of the inferior interocular line and shorter than the combined length of the pedi-

[1] Deutsch. Ent. Zeit. 1910, p. 364.

First form on press April 28, 1924.

cellum and first joint of the flagellum; flagellum filiform, third, fourth and fifth joints subequal; scutum shining, with distinct, medium sized punctures which are separated laterally by a distance equal to the width of the puncture but medianly are much closer; scutellum with punctures like the scutum but much more widely separated; dorsal aspect of the propodeum coriaceous, with longitudinal wrinkles basally (the length of these wrinkles varies to some extent; in some specimens they extend beyond the middle of the propodeum); dorsal aspect of the propodeum perpendicular, transversely aciculate, the median depression elongate; sides of the propodeum finely longitudinally rugulose; inner spur of the posterior tibia two thirds as long as the basitarsus; abdomen shining, but when highly magnified feebly laminate; the apical margins of the tergites distinctly depressed; pygidium polished, with a few distinct punctures laterally, about two times as long as basal width; first abscissa of radius longer than either of the two following, second and third subequal (in certain paratypes the second abscissa is slightly longer than the third). Black; the venter of the abdomen, the apical margins of all tergites pale ferrugineous; the anterior tarsi, the fou posterior tarsi beneath and the spines pale ferrugineous; the spines on the basal part of the legs white; body densely clothed with silver pile; wings dusky hyaline, slightly iridescent; venation dark brown.

Male.—Length, 5.5 mm. The anterior margin of the clypeus is not as broadly depressed as in the female, the convex portion slopes more abruptly; front more strongly coriaceous than in the female; superior interocular line half as long as the inferior interocular line, distinctly greater than the length of flagellar joints one and two but not quite as great as the length of joints one, two and three; flagellum very stout, the basal joints unusually short, the third and fourth shorter than the fifth; scutum sculptured similar to the female; dorsal aspect of the propodeum with the longitudinal wrinkles better defined than in the female; the ventral portions and the sides of the propodeum coriaceous; legs stout; the inner spur of the posterior tibiae three fourths as long as the hind basitarsus; apical tergite with a gentle, arcuate emargination. Colored as in female; wings hyaline, venation dark brown.

A paratype female from South Seymour is smaller than the other females (6 mm.) and has a decidedly polished appearance; the sculpture is not as coarse, but otherwise it seems to agree. The paratype females from South Seymour have the wings almost hyaline.

Type Locality.—Albemarle, Galapagos Islands.

Paratype Locality.—South Seymour, Galapagos Islands.

Described from six females (one type), one of which has lost its head, and fifteen males (one allotype) collected at the type locality March 21, 1899, and from three females from the paratype locality collected April 23, 1923.

Type, allotype, paratypes.—Cat. No. 5513 U. S. N. M.

Paratypes from the paratype locality returned to the collection of the New York Zoological Society.

Aporinellus galapagensis sp. nov.

This new species is very similar to the Nearctic *fasciatus* (Smith) but differs in minor ways, and it seems to be worthy of a name.

Male.—Length, 4.5 mm. Anterior margin of the clypeus truncate; frons finely granular with an indistinct median longitudinal line; vertex slightly raised between the posterior ocelli, shining, very feebly sculptured; postocellar line subequal with the ocellocular line; antenna stout, filiform; flagellum with short, dark bristles beneath; third antennal joint about one fourth shorter than the fourth; posterior margin of the pronotum broadly arcuate; pronotum, scutum and scutellum subopaque, finely granular; propodeum finely granular but when highly magnified appears transversely laminate, slightly depressed at the basal middle; abdomen finely laminate; inner spur of the posterior tibiae four fifths as long as the posterior basitarsus; legs feebly spined; first abscissa of the radius slightly shorter than the second; the second abscissa of the cubitus subequal with the second abscissa of the radius; second recurrent received well before the end of the second cubital cell; nervulus very slightly ante-furcal. Black; densely clothed with silver pile which forms broad fasciae at the apical margins of the tergites; wings hyaline, strongly dusky beyond the end of the second cubital cell; venation black.

Type Locality.—South Seymour, Galapagos Islands.

Described from a single male collected April 23, 1923

Type.—Cat. No. 26600 U. S. N. M.

Chalcis sp.

A single male collected April 23, 1923, at South Seymour represents a small species which does not seem to agree with any of the described forms from South or North America, but inasmuch as the species of *Chalcis* are so difficult to distinguish, and this is particularly true in the male, it seems unwise to describe this specimen until more material has been collected.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship ot William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

NEUROPTERA[1]

FROM THE WILLIAMS GALAPAGOS EXPEDITION

By Nathan Banks

Neuroptera have not previously been reported from the Galapagos Islands; the small collection taken by William Beebe, though broken, are of much interest. None appear identical with any on the mainland, but all are related to Central American forms, the Megalomus, however, showing some affinity to certain South American species. The types are in the collection of the N. Y. Zoological Society.

Family MYRMELEONIDAE

Myrmeleon perpilosus sp. nov.

Belonging to the group of *M. crudelis.* in which there are no black bristles above on the thorax. The face and vertex black, the face shining, no pale spots on the vertex. The pronotum with two pale spots each side and the anterior corners pale, and there are traces of pale in the middle of the meso- and metathorax. Pleura wholly dark. Abdomen with the tips of last two segments pale, and a pale spot near tip of some of the other segments; entire abdomen clothed with long white hair, rather longer than usual, and in the male much longer than in *M. crudelis* and allies. In the female the last ventral segment has black hair. Legs pale, the femora with broad brown stripe, tibia lined with brown, tarsal joints dark at tips. Wings moderately narrow, acute at tips; hyaline, veins dotted with dark, the main veins dark in streaks at all connections; costals simple, unforked, in cubital area three rows of cells, eight branches to radial sector, seven cross-veins before radial sector in fore wings.

Length of front wings, 27 mm.

Locality.—Conway Bay, Indefatigable, Galapagos Islands.

Collected.—April 1, 1923.

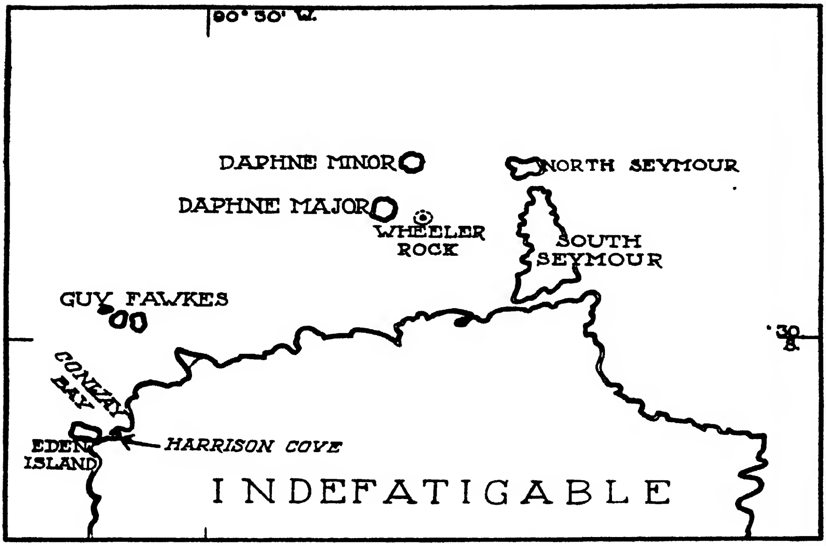
Family CHRYSOPIDAE

Chrysopa nigripilosa sp. nov.

Greenish, much marked with black. Palpi mostly black; a black stripe on each cheek under each eye, a black spot under base of each antenna; antennae dull brownish. Pronotum with many minute dark dots, from each a

[1] Department of Trop. Research No. 183.

First form on press November 3, 1924.



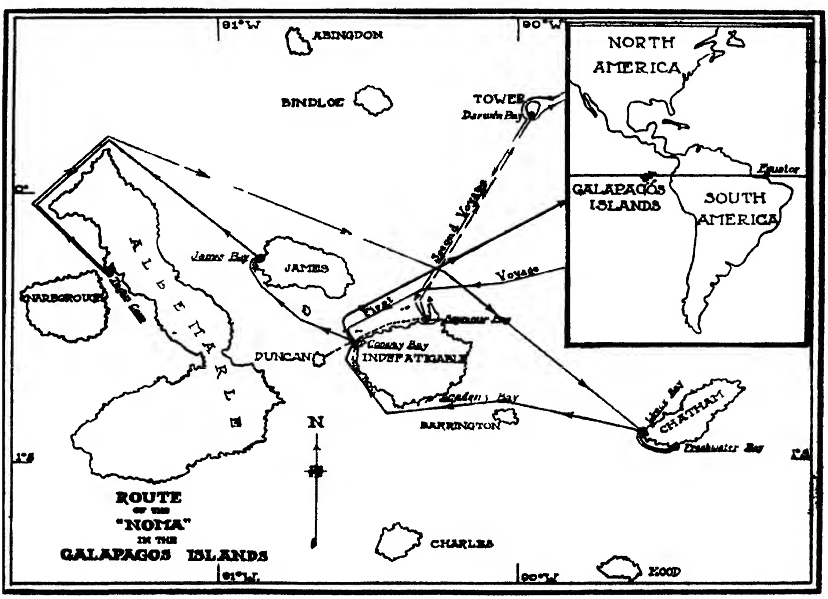


Plate A SKETCH MAP OF GALAPAGOS ISLANDS

Route of the *Noma*, and details and location of the Archipelago.

black hair, rest of thorax also with short, black hair, and a few dark spots. Basal part of the abdomen with a broad median dark stripe, beyond broken up; ventral segments five to seven dark. Legs pale, with black hair. Wings hyaline, stigma with about three dark spots; venation pale, much marked with black, the gradates and several of the basals wholly dark, the costals and radial cross veins black at ends, and nearly all connections of veins dark. The cubital vein just before the third cubital cell is broadened; the divisory vein ends much beyond the cross-vein; gradates divergent, inner row (of about 4) nearer to the radial sector than to the outer row (of about 7). Hind wings marked much as the fore wings, but less strongly; about three inner and six outer gradates. Both wings are moderately slender, and acute at tips.

Length of fore wing, 11 mm.

Locality.—South Seymour, Galapagos Islands.

Collected.—April 20, 23, 1923.

Chrysopa galapagoensis sp. nov.

Pale yellowish (probably greenish alive), a black spot on each cheek under the eye, palpi marked with black. Pronotum as broad as long, narrowed in front, with rather long hair on sides. Wings hyaline, venation pale, marked with black; in the fore wing the gradates, several basal cross-veins, the radial, and some cubital cross-veins wholly dark, the costals and some median cross-veins partly dark; stigma greenish. In hind wings the gradates wholly, and costals and radials partly, dark. Both wings acute at tips, the fore wings not especially slender. The gradates in parallel series, about six or seven in each, the inner row almost as near to outer row as to the radial sector; divisory veinlet ends before the cross-vein.

Length of fore wing, 10 mm.

Locality.—South Seymour, Galapagos Islands.

Collected.—April 23, 1923.

Family HEMEROBIIDAE

Megalomus darwini sp. nov.

Face tawny, vertex darker, antennae pale brownish, paler on basal joint, thorax and abdomen dark; legs pale, front and mid tibiae with band before middle and another near tip, hind tibia very long. Wings rather slender for a Megalomus, nearly two and one-half times as long as broad, brownish, rather darker behind than in front, with darker clouds over some of the cross-veins; venation dark with here and there pale spots or short streaks, margin alternately pale and dark, gradates wholly dark; hind wings pale, the venation wholly dark, except some inner gradates which are hyaline. The fore wings have a broad costal area and most of the costal cross-veins forked. There are but four branches of the radial sector, the first however with two branches from the upper side, the gradate behind this branch is hyaline; outer gradates number about twelve. In hind wings the inner gradates are hyaline and hardly visible, and the four outer are not very distinct. Appendages short, not promi-

nent, lower appendages short, outer side rounded and end in a corneous point.

Length of fore wing, 6 mm.

Locality.—Conway Bay, Indefatigable, Galapagos Islands.

Collected.—April 1, 1923.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

Zoologica, Vol. V, No. 18.

ISOPODS[1]

FROM THE WILLIAMS GALAPAGOS EXPEDITION

BY WILLARD G. VAN NAME[2]

(Plates VIII–XIX incl.)

The isopods collected by the Harrison Williams Expedition at the Galapagos Islands comprise eleven species, and are of especial interest as no less than nine of them are terrestrial forms, while up to the present time but three terrestrial isopods (two of them widely ranging species) have been recorded from the islands. The collection is a small one, totaling only about fifty specimens, and of necessity was hastily made at a few stations only, yet that so many species of these small creatures, inconspicuous in appearance and secretive in habits, were obtained, speaks highly for the diligence and industry of the naturalists of the expedition, and indicates moreover that future collecting will probably add to the list of Galapagos isopods a number of terrestrial as well as marine species.[3] I wish to express my thanks to Mr. William Beebe for the opportunity of studying this collection.

The following are the eleven species obtained by the Harrison Williams Expedition and dealt with in the present article. Only the two which are marked with an asterisk were previously known from the Galapagos Islands or vicinity. Five of them are considered to be new species.

Suborder FLABELLIFERA (Marine)

Cirolana mayana Ives, 1891.
? **Meinertia gaudichaudii* (Milne-Edwards), 1840.

Suborder ONISCOIDEA (Terrestrial)

Tylos latreilli Audouin and Savigny, 1826.
Philoscia culebroides, sp. nov.
Philoscia williamsi, sp. nov.
Philoscia nomae, sp. nov.
Porcellionides pruinosus Brandt, 1833.
Rhyscotus laxus, sp. nov.
* *Cubaris galapagoensis* Miers, 1877.
Cubaris beebei, sp. nov.
Ligyda baudiniana (Milne-Edwards), 1840.

The literature dealing with the Isopoda of the Galapagos Islands and vicinity is not extensive and refers mainly to marine species,

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[1] Cont. Department of Trop. Research No. 184.

[2] Contribution from the Laboratory of Invertebrate Zoology of the American Museum of Natural History, New York.

[3] Beebe (Galapagos, World's End, p. 329) mentions the relative abundance of isopods among the few land invertebrates on Tower Island.

First form on press December 11, 1924.

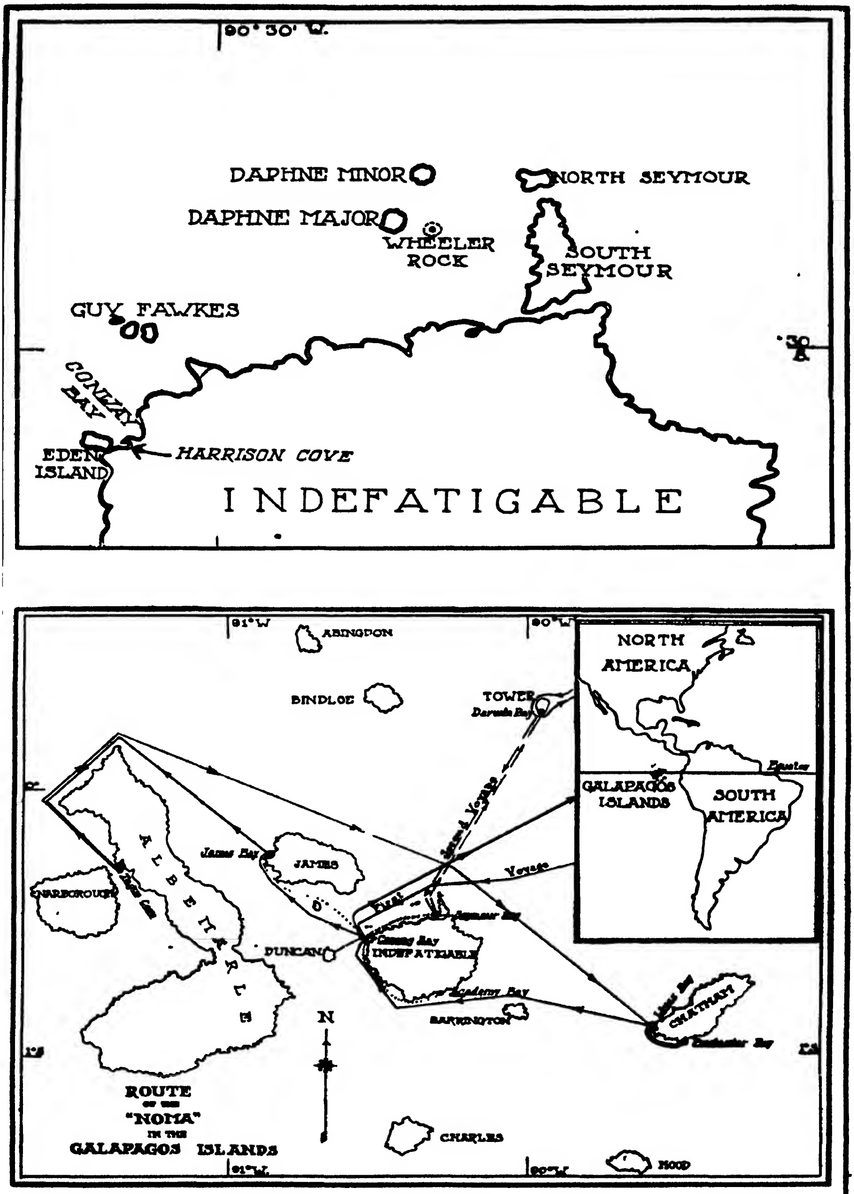

Plate A. SKETCH MAP OF GALAPAGOS ISLANDS
Route of the *Noma*, and details and location of the Archipelago.

many of them from deep water. It comprises two short articles by Richardson (1901, 1913; see bibliography at the end of this article) and Hansen's (1897) account of those collected by the U. S. *Albatross* in 1891. Other references and descriptions are scattered, and are noted in the following pages under the species to which they apply.

I have found the following isopods, only sixteen in number even when deep sea forms are included, recorded from the islands and neighboring waters.

Suborder CHELIFERA

Family TANAIDAE

***Tanais stanfordi* Richardson.**

Tanais stanfordi Richardson, 1901. *Proc. Washington Acad. Sci.*, III, *p.* 565, *figs.* 58–60.

Clipperton Island lagoon.

Family APSEUDIDAE

***Apseudes galapagensis* Richardson.**

Apseudes galapagensis Richardson, 1913. *Proc. U. S. Nat. Mus.*, XLIII, *p.* 159, *figs.* 1, 2.

Albatross Station 2807, off Chatham Island, 812 fathoms.

Suborder FLABELLIFERA

Family AEGIDAE

***Aega acuminata* Hansen.**

Aega acuminata Hansen, 1897. *Bull. Mus Comp. Zool Harvard*, XXXI, *p.* 104, *pl.* II, *figs.* 3–3*b*.

Albatross Station 3403, Lat. 0° 58′ 30″ S., Long. 89° 17′ W., 384 fathoms.

***Aega longicornis* Hansen.**

Aega longicornis Hansen, 1897. *Bull. Mus Comp. Zool. Harvard*, XXXI, *p.* 106, *pl.* II, *figs.* 5–5*b*; *pl.* III, *figs.* 1–1*a*.

Albatross Station 3402, Lat. 0° 57′ 30″ S., Long. 89° 3′ 30″ W., 421 fathoms.

***Aega plebeia* Hansen.**

Aega plebeia Hansen, 1897. *Bull. Mus. Comp. Zool. Harvard*, XXXI, *p.* 105, *pl.* II, *figs.* 4–4*d*.

Albatross Station 3402, Lat. 0° 57′ 30″ S., Long. 89° 3′ 30″ W., 421 fathoms; also other stations to depths of 978 fathoms.

Family CYMOTHOIDAE

***Meinertia gaudichaudii* (Milne-Edwards).**

Ceratothoa gaudichaudii Milne-Edwards, 1840. See Schioedte and Meinert, 1881–1883, *Naturhist. Tidsskr.* (3) XIII, *p.* 335, *pl.* XIII, *figs.* 11–15; *pl.* XIV, *figs.* 1–5.

Widely distributed in the Pacific; parasitic in mouth of fish of the genus *Thunnus* and allies. Black Bight, Albemarle Island and 200 miles north of Wenman Island (Richardson, 1901, p. 568). Young specimen, probably this species, collected by the Harrison Williams Expedition.

Cymothoa exigua Schioedte and Meinert.

Cymothoa exigua Schioedte and Meinert, 1884. *Naturhist. Tidsskr.* (3) XIV, *p.* 232, *pl.* VI, *figs.* 7, 8, and Richardson, 1905, *p.* 250, *fig.* 261.

Charles Island, from mouth of fish *Citharichthys sordida.*

Aegathoa excisa Richardson.

Aegathoa excisa Richardson, 1901. *Proc. Washington Acad. Sci.*, III, *p.* 567, *fig.* 61. Nierstrasz, 1915, *Zool. Med. Rijks Mus. Nat. Hist. Leyden*, *p.* 103. Monod, 1922, *Assoc. Franc. Avanc. Sci., Congrès de Montpellier*, 1922, *pp.* 405, 409.

From the fin of a dolphin (*Coryphaena hippurus*) in Lat. 5° N., Long. 90° W.

Suborder Valvifera

Family ARCTURIDAE

Arcturus abyssicola Beddard.

Arcturus abyssicola Beddard, 1886. (See *Rept. Voy. Challenger* XVII, *part* 1, *p.* 98, *pl.* XXI, *figs.* 5–8.) (Description by Beddard from a specimen dredged near the Low Archipelago in 2885 fathoms and doubtful specimens from between Australia and New Guinea, 1400 fathoms.)

Albatross Station 2807, off Chatham Island, 812 fathoms (Richardson, 1913, p. 159).

Suborder Asellota

Family MUNNOPSIDAE

Eurycope pulchra Hansen.

Eurycope pulchra Hansen, 1897. *Bull. Mus. Comp. Zool. Harvard*, XXXI, *p.* 97, *pl.* I, *figs.* 1–1*i*.

Albatross Station 3418, Lat. 2° 34′ N., Long. 92° 6′ W., 1360 fathoms, also one other station in 1471 fathoms.

Eurycope scabra Hansen.

Eurycope scabra Hansen, 1897. *Bull. Mus. Comp. Zool. Harvard*, XXXI, *p.* 100, *pl.* I, *figs.* 2–2*d*; *pl.* II, *fig.* 1.

Albatross Station 3418, Lat. 2° 34′ N., Long. 92° 6′ W., 1360 fathoms.

Munnopsis longiremis Richardson.

Munnopsis longiremis Richardson, 1913. *Proc. U. S. Nat. Mus.*, XLIII, *p.* 161, *figs.* 3, 4.

Albatross Station 2807, off Chatham Island, 812 fathoms.

Suborder Epicaridea

Family BOPYRIDAE

Cryptione elongata Hansen.

Cryptione elongata Hansen, 1897. *Bull. Mus. Comp. Zool. Harvard*, XXXI, *p.* 112, *pl.* III, *figs.* 5–5a; *pl.* IV, *figs.* 1–1g; Richardson, 1899, *Proc. U. S. Nat. Mus.*, XXI, 1899, *p.* 869; *Ann. Mag. Nat. Hist.* (7) IV, *p.* 338; Bouvier, 1900, *Trav. Stat. Zool. Wimereux*, VIII, *p.* 285; Richardson, 1904, *Proc. U. S. Nat. Mus.*, XXVII, *p.* 87; 1905, *Bull. No.* 54, *U. S. Nat. Mus.*, *p.* 520, *fig.* 567 (after Hansen).

Albatross Station 3407, Lat. 0° 4′ S., Long. 90° 24′ 30″ W., 885 fathoms, parasitic on the shrimp *Nematocarcinus agassizii* Faxon.

Suborder Oniscoidea

Family ONISCIDAE

Porcellio laevis Latreille.

Porcellio laevis Latreille, 1804. (Very widely distributed, especially in the warmer parts of the world, but also in temperate regions. See Richardson, 1905, *p.* 614 and Budde-Lund, 1885, *p.* 138, for synonyms, distribution, etc.) Chatham Island (Hansen, *Bull. Mus. Comp. Zool. Harvard*, XXXI, *p.* 124; Richardson, 1905, *p.* 615, *fig.* 666).

Cubaris galapagoensis Miers.

Cubaris galapagoensis Miers, 1877. *Proc. Zool. Soc. London*, 1877, *p.* 74, *pl.* XII, *figs.* 2–2c.

Charles Island (Miers). Collected also by the Harrison Williams Expedition.

Family LIGYDIDAE

Ligyda exotica (Roux).

Ligia exotica Roux, 1828. Widely distributed on the shores of tropical and subtropical regions. See Richardson, 1905, *p.* 676, *figs.* 716–718, and Van Name, 1918, *Bull. American Mus. Nat. Hist.*, XLIII, *p.* 72, for synonyms).

"Guadaloupe and Clipperton Island" (Richardson, 1901, p. 568, under name *Ligia exotica*).

DESCRIPTIONS OF SPECIES COLLECTED

Suborder Flabellifera

Family CIROLANIDAE

Genus *Cirolana* Leach, 1818

Cirolana mayana Ives.

Cirolana mayana Ives, 1891, *Proc. Acad. Nat. Sci. Philadelphia*, ann. 1891, *p.* 186, *pl.* VI, *figs.* 3–10; Richardson, 1901, *Proc. U. S. Nat. Mus.*, XXIII, *p.* 512; Moore, 1902, *Bull. U. S. Fish Comm.*, XX, *part* 2, *p.* 166, *pl.* VIII, *figs.* 1–5; Richardson, 1905, *Bull.* 54, *U. S. Nat. Mus.*, *p.* 87, *figs.* 66–70; Boone, 1921, *Univ. of Iowa Studies*, IX, *No.* 5, *p.* 92.

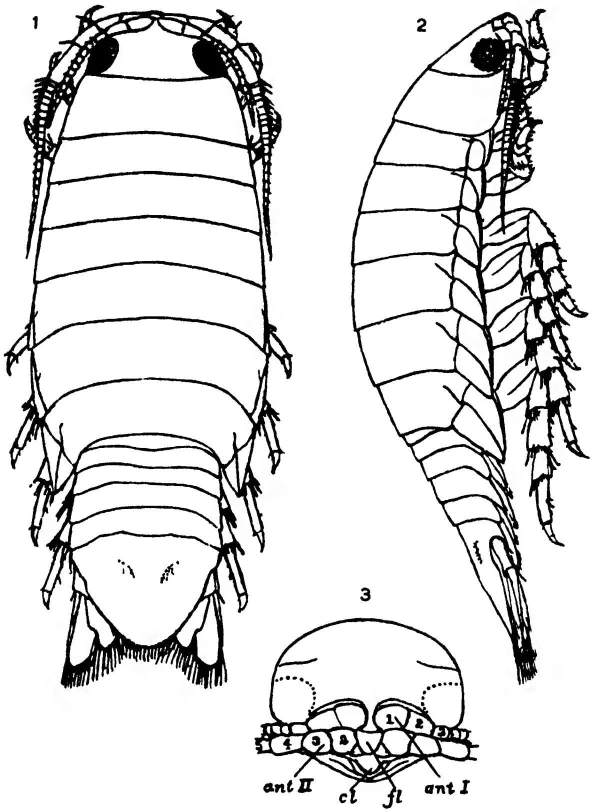

Plate VIII. 1–3, *Cirolana mayana* Ives, 1891. Dorsal and lateral views, × 11, and front view of head, × 15; *ant.* antennae; *cl.* clypeus; *fl.* frontal lamina.

(Plate VIII, figs. 1–3).

This is a species widely distributed on the West Indian region and the Caribbean Sea, and reported also from San Francisco Bay, Lower California, by Richardson (1905, p. 87), who examined a large number of specimens from the last named locality without being able to detect any specific differences separating them from West Indian localities. It is represented in the Galapagos collection by a single specimen 8.3 mm. long, which I have compared with specimens from Porto Rico, Dominica, and Andros Island, Bahamas, likewise without finding any basis for separating the Pacific and West Indian forms.

The head has its anterior border produced into a small triangular point between the bases of the first antennae. This point meets the frontal lamina extending up from below; the latter, seen in an anterior view, forms a small

convex keystone-shaped plate separating the bases of the second antennae; in a strictly dorsal view this plate is only narrowly visible and projects but little beyond the curve formed by the basal segments of the first antennae which form the front outline of the body when seen from that aspect. The first antennae have the two basal segments of the peduncle broad and flattened, though their width shows chiefly in an anterior view of the head; the third is much smaller and narrower: the flagellum, which is slender and has 13 articles in the present specimen, reaches near the posterior end of the first thoracic segment when drawn back. The second antennae have five segments in the peduncle, but the basal one is reduced and entirely concealed by the second in a dorsal view, and almost entirely so even in a front view of the head; the flagellum is stout and reaches well back along the fourth thoracic segment; it has 23 articles in this specimen. The anterior end of the clypeus is free and forms a rounded-triangular, downwardly and forwardly projecting process on the underside of the head in front of the mouth. The legs are stout, laterally compressed and provided with numerous stout spines. The abdomen is wide; its segments are all distinct; only the fourth segment has the lateral angles produced into prominent posteriorly directed points. The telson bears, as do the branches of the uropoda, a fringe of rather short hairs on the posterior part of the border. The telson has a pair of shallow depressions on the basal part of the upper surface and is rounded behind, but rather more narrowly so than is represented in the previously published figures (this is true of the West Indian specimens examined also). The internal branches of the uropoda scarcely exceed the telson; they are wide and have the external border emarginate. The external branch appears to present a good character for distinguishing this from other American species of the genus in its unusual length, as it exceeds the internal branch in length by about one-fifth. Color yellowish, with blackish pigment in irregular stellate dots on the back.

For further details the reader is referred to Richardson, 1905, p. 87.

The Galapagos specimen, the first record from those islands, was taken in damp sand on the shore of Indefatigable Island (Collector's number 2014). It is not fully grown; the species reaches over 12 mm. in length.

Family CYMOTHOIDAE

Genus *Meinertia* Stebbing, 1893

? *Meinertia gaudichaudii* (Milne-Edwards).

Cymothoa gaudichaudii Milne-Edwards, 1840, *Hist. Nat. Crust.*, III, *p.* 271.
Ceratothoa rapax Heller, 1865, *Reise Novara, Crust.*, *p.* 146, *pl.* XII, *fig.* 17.
Ceratothoa gaudichaudii Schioedte and Meinert, 1883, *Naturh. Tidsskr.* (3) XIII, *pp.* 335-340, *pl.* XIII, *figs.* 11-15; *pl.* XIV, *fig.* 5.
Meinertia gaudichaudii Stebbing, 1893, *Hist. Crust.*, *p.* 345; Richardson, 1899, *Proc. U. S. Nat. Mus.*, XXI, *p.* 829; 1899, *Ann. Mag. Nat. Hist.*, (7) IV, *p.* 171; 1901, *Proc. Washington Acad. Sci.*, III, *p.* 568; Stebbing, 1902, in Willey, *Zool. Results*, *p.* 643; Richardson, 1905, *Bull.* 54, *U. S. Nat. Mus.*, *p.* 237, *figs.* 241-245; 1910, *Proc. U. S. Nat. Mus.*, XXXVIII, *p.* 79, *figs.* 1, 2.

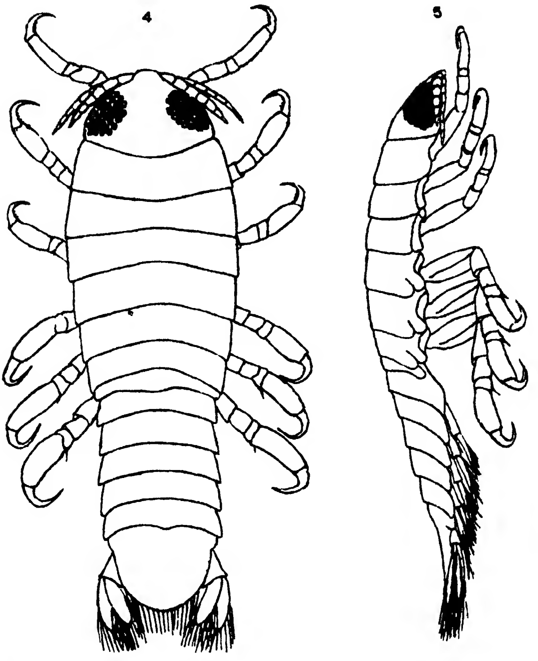

Plate IX. 4–5, young individual, probably *Meinertia gaudichaudii* (Milne-Edwards), 1840. Dorsal and lateral views, × about 18.

(Plate IX, figs. 4–5).

The larval isopod, 4.1 mm. long, shown in Figs. 4 and 5 is in too early a stage for sure identification in the absence of other specimens in stages to connect it with the adult, but I refer it here provisionally, rather than to any allied species, largely on the ground that *M. gaudichaudii* is a widely distributed and apparently common Pacific species that has been twice recorded from the Galapagos Islands and their vicinity.

As far as I am aware, the only figure and description of the young of this species is that given by Schioedte and Meinert (1883, Naturhist Tidsskr. (3) XIII, p. 339, Pl. XIV, fig. 5; figure reproduced in Richardson 1905, Fig. 243) which represents a younger individual only 3.7 mm. long. The differences between this and the present specimen are, I think, explainable by the greater age and more advanced development of the latter.

In alcohol the specimen is yellowish with the usual irregularly stellate black pigment spots on the upper parts. The first antennae reach, when drawn back, to about the rear corner of the head and are somewhat thick and inflated, consisting of 7 segments. These arise quite close together. The second antennae are longer and much slenderer, consisting of 9 segments and reaching half way along the first thoracic segment. The eyes are large and well pigmented and contain 7 rows of ocelli, with 8 in the longest row.

The six pairs of thoracic limbs are rather long and, excepting the first pair, rather stout. They are laterally compressed, with well developed hooked dactyli, which on the three anterior pairs have a few rather poorly developed dentations on the basal third of their concave aspect, those of the others appear practically smooth. Spines were not demonstrated on the propodus of any limb; the carpus of the posterior pairs, however, is provided with a distally situated spine. The propodus of the second pair is noticeably expanded. The posterior three legs have the thighs keeled, and are noticeably larger and longer than the anterior ones, increasing successively in length and stoutness.

The telson is moderately wide and smoothly rounded behind. It is exceeded a little by the rather narrowly oval branches of the uropoda, which, as well as the rear border of the telson itself, bear a fringe of hairs.

Meinertia gaudichaudii is reported to be found parasitic in the mouth of species of *Thunnus* (tunnies). Its previously reported range includes the American Pacific coast from Mazatlan to Chile, and the Louislade Archipelago southeast of New Guinea (Richardson, 1905, 1910), as well as the following Galapagos localities (Richardson, 1905): Black Bight, Albemarle Island, and 200 miles north of Wenman Island.

The present immature specimen was found attached just behind the gills of a fish (*Trachinotus paloma*) in Conway Bay, Indefatigable Island, March 29, 1923.

Suborder Oniscoidea

Family TYLIDAE

Genus *Tylos* Latreille, 1829

The isopods of this genus, which constitutes a family by itself, are distinguished from the other terrestrial forms by having the uropoda modified to form, in conjunction with inwardly directed plate-like processes of the fourth and fifth abdominal segments, a cover or operculum for the other abdominal appendages which they entirely conceal. The uropoda are therefore visible only in a ventral view of the abdomen.

Tylos latreilli Audouin and Savigny.

Tylos latreilli Audouin and Savigny, 1826, *Descript. Égypte, p.* 285, *pl.* XIII, *fig.* 1 (*fide* Richardson); Budde-Lund, 1885, *Crust. Isop. Terrest., p.* 273; Richardson, 1902, *Trans. Connecticut Acad. Sci.*, XI, *p.* 300, *pl.* XL, *fig.* 56; 1905, *Bull. No.* 54. *U. S. Nat. Mus., p.* 586, *figs.* 646, 647.

(Plates X-XI, figs. 6–10).

See Budde-Lund, 1885, p. 273, for other synonyms and references.

This is a species widely distributed in the Mediterranean region. It has been recorded also from Odessa, Russia and in the New World from the Bermudas, Santa Marta, Colombia, and Florida. There are specimens in the Galapagos collection which I do not feel justified in separating specifically from this form. For comparison I have had available specimens from Adria, Italy, received from Dr. Karl W. Verhoeff, and others from Porto Rico and Key Largo, Florida, in the American Museum collections.

From the Italian and Porto Rican specimens, the Galapagos examples differ in a few minor points, notably in having the narrow upper end of the

epistome less prominently raised above the surface of the forehead, into which it passes with a less conspicuously impressed suture. Moreover in the Galapagos specimens the lobes of the head below the eyes are always wide and broadly truncated, though more variable in form in the others, and the rear end of the body (and of the opercular valves) is somewhat more broadly rounded. The telson moreover has its lower or terminal border always straight without any trace of the slight tendency to emargination usually noticeable in the specimens from the other localities. Nevertheless these differences are slight

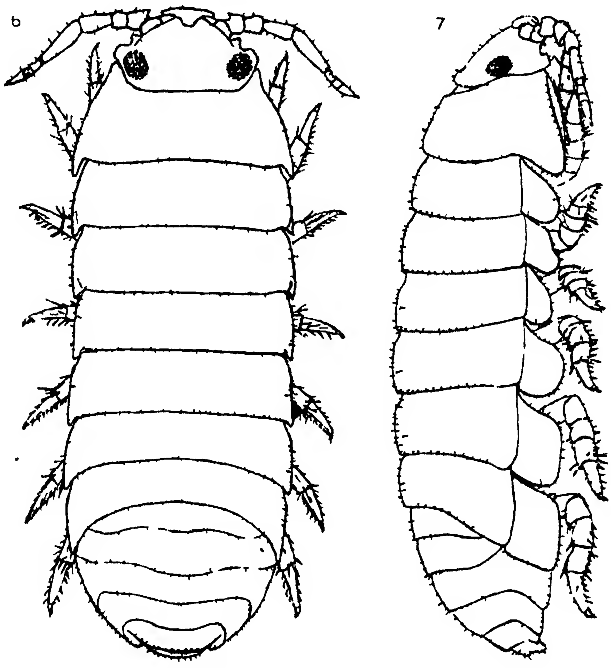

Plate X 6 7, *Tylos latreilli* Adouin and Savigny 1826 Dorsal and side views, × 8 75

and apparently more or less inconstant, and I am unwilling with the material available to attribute much weight to them, since the Florida specimens are more or less intermediate, approaching more those from the Galapagos. It is not unlikely that a species so widely distributed will prove divisible into geographical races, but I do not feel that such a division should be attempted without much more material, collected at more numerous localities, than I have at hand.

As in the case of many other widely distributed and supposedly well known species, the published figures and descriptions leave a good deal to be desired, so that the following notes on, and figures of, the Galapagos specimens seem worth including here.

Body of oblong outline, rounded before and behind when seen from above. It can be rolled up into a ball. Back highly arched; body surface minutely granular and slightly uneven, but no actual tubercles are developed except a few minute ones on the front of the epistome and clypeus. The surface of the body, limbs and antennae bears rather thinly scattered short, stiff hairs or minute setae, rising from minute depressions, which latter are more conspicuous and form a definite row along the rear border of the segments. The largest specimen, probably a male, is 10 mm. long. The others are all considerably

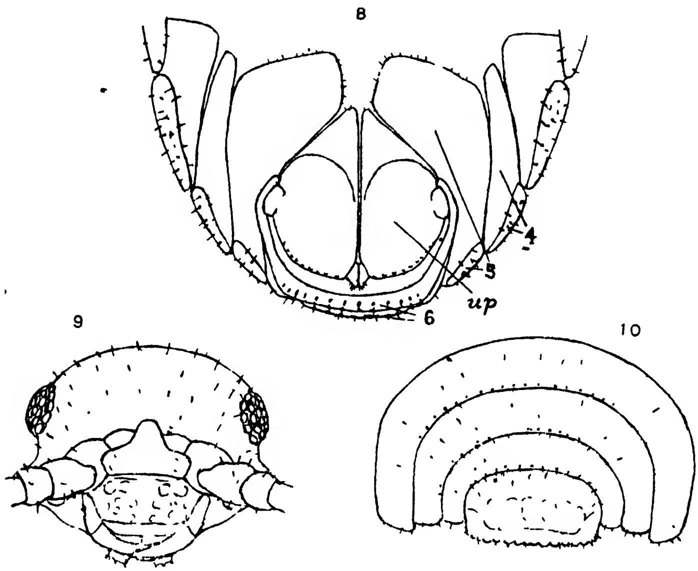

Plate XI. 8–10 *Tylos latreilli* Audouin and Savigny, 1826 8, ventral view of abdomen and opercular plates formed by the uropoda (*up*) and segments 3, 4, and 5 of the abdomen, × 18. 9, front view of head × 14.5. 10, rear end of body, × 14.5.

smaller and evidently not adult. Color white with scattered minute blackish pigment spots.

Head well set back into the thorax; narrowed toward the front and provided with a truncated obliquely projecting lobe under each eye. In front of this lobe (between it and a wide notch occupied by the base of the second antennae) there is a small pointed lobe. The extreme front of the head is formed by the somewhat triangular epistome, below which the clypeus forms a transversely oblong plate.

Eyes well developed, with nearly 30 ocelli. Second antennae rather short, with a five-jointed peduncle, unless a small movable plate on the anterior surface of the head above each lateral wing of the epistome may be the rudiment of an additional joint. The terminal joint of the peduncle is the longest, and bears a flagellum which about equals that joint in length and which is divided into four articles. The first article is somewhat curved and

bears at its proximal end a small tubercle on its upper outer aspect. The third article is the longest; the fourth is reduced to a mere conical point.

The thoracic segments each have a considerable degree of individual curvature in an antero-posterior direction, and have the exposed part considerably but not abruptly raised above the part which slips under the segment in front. The thoracic segments except the first have the epimera distinctly articulated. The first segment has the posterior lateral corner well extended back and narrowly rounded at the apex of the somewhat acute angle which it forms. The inferior margin of the segment is not reflected outward to form a border, but it is double, owing to the existence of a narrow sulcus which extends along the anterior four-fifths of its length. The sulcus is slightly oblique in position so that it is visible in a lateral as well as in a ventral view of the segment, and it gradually closes posteriorly without forming a notch. None of the succeeding segments bear coxopodite processes. The thoracic epimera are rounded, except those of the sixth and seventh which are more squarely cut off. The epimera of the third, and especially of the fourth segments, are so small as to suggest that they have been injured or deformed, but this is normal. The legs are rather short and fairly stout, and of somewhat compressed cross section. They are unusually spinous.

The telson is transversely oblong, with the upper margin arched. A rough transverse ridge or elevation crosses its surface near the rear or inferior border which projects a little farther ventrally than the border of the other abdominal segments.

The form of the opercular plates is shown in fig. 8. Those of the fifth abdominal segment do not come together on the median line.

Five specimens were collected under dead wood and slabs of lava, on Tower Island, April 29th, 1923. Collector's number 2471.

I may add that in *Tylos spinulosus* Dana, 1853, from Tierra del Fuego, (Dana, 1853, p. 717, Atlas, 1855, Pl. XVIII, figs. 1a–1c) the antennae have a three-jointed flagellum and Dana's figure of the antennae shows an appendage entirely different in proportions and segmentation from those of the present species, so that it appears to be distinct generically.

Family ONISCIDAE

Genus *Philoscia* Latreille, 1804

This genus, which comprises a large number of species, many of them of minute size and distinguishable from each other only with considerable difficulty, is represented in tropical and South America by many forms, the larger part of them still undescribed, while only more or less inadequate descriptions and illustrations are available in the case of many of those that have come to the notice of zoologists. In the Galapagos collection the genus is represented by six specimens, all of them more or less unsatisfactory on account of loss of parts or immaturity, but no less than three apparently perfectly distinct species are represented. I cannot identify them with any previously described forms, at least not with the information about the latter that is now available.

While under ordinary circumstances the description of new species of this perplexing group on the basis of such inadequate material would be entirely inexcusable, the exceptional interest which pertains to the land fauna of the Galapagos Islands seems to justify an exception in this case, especially since the remote and narrowly limited habitat greatly diminishes the probability of introducing more confusion into the already unsatisfactory understanding that we have of this genus, and will probably make the recognition of the forms by future collectors on the islands easy, even though the limitations in the amount and condition of the material prevent the descriptions being as full as they should be.

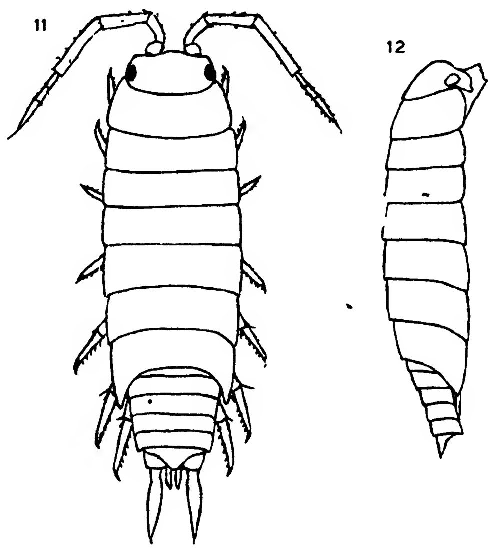

Plate XII. 11–12. *Philoscia culebroides*, new species. Dorsal view and lateral outline of body of male, × 24.

Philoscia culebroides, sp. nov.

(Plate XII, figs. 11–12).

The single specimen in the collection is a male a little under 2.5 mm. long. The color is the usual purplish brown above with irregular oblong light markings on the dorso-lateral regions, and whitish below, that is commonly found in this group. The body surface is quite smooth and shows little trace of pubescence, though the antennae bear scattered, short, stiff hairs. The integument is extremely soft, perhaps because of recent moulting. The body is narrow, the abdomen large and but little narrower than the thorax at its anterior end. It forms nearly one-fourth of the body length.

The head is wide and has the front outline sinuously curved when seen from above so that it is slightly prominent in the middle and under each eye. The sides of the head reach down into a large, somewhat square lobe-like ex-

tension below each eye, but this is appressed to the side of the head and does not project either laterally or forward. The eyes are well developed and pigmented. The second antennae are fairly long, reaching beyond the third thoracic segment when well drawn back. Their flagellum is elongate and has the two first articles about equal; the third or terminal article is considerably the longest and bears a strong terminal bristle.

The first three thoracic segments have the posterior lateral angles more or less rounded and not extended backward. The others are not rounded off, and extend backward in a progressively increasing degree.

The legs are moderately long, rather stout, and have well developed spination. I could not distinguish any special modification of the anterior pair or pairs of legs, except that, as usual, they are shorter and proportionately stouter than those farther back.

The abdomen does not taper so much as in many allied species. The posterior lateral angles of the third, fourth and fifth abdominal segments are only produced backward to an insignificant extent. The telson is obtusely triangular with the tip considerably rounded off and the sides a little concave. The inner branches of the uropoda are small, but the outer ones, which are of more or less terete cross section, are large and long, about equaling in length the telson and the three preceding segments taken together.

This specimen is very close to *Ph. culebrae* Moore, 1902 (See Bull. U. S. Fish. Comm., XX, Part 2, p. 176, Pl. XI, figs. 13–17; also Richardson, 1905, p. 604, Fig. 660), from Culebra Island near Porto Rico, but I cannot refer it to that species on account of differences in the form and proportion of certain parts of the body. In the Galapagos specimen the head is proportionately wider, the downwardly projecting lobes under the eyes larger and more extended at the posterior ventral angle; the antennae longer, the first two joints of their flagellum more nearly equal; the abdomen somewhat larger and telson longer in proportion to its width.

The label bears the collector's number 2416. The specimen was taken on the underside of a slab of lava on Tower Island, April 28th, 1923.

Philoscia williamsi, sp. nov.

(Plate XIII, figs. 13–15).

Named for Mr. Harrison Williams, patron of the expedition.

This species appears to be a member of the same division of the genus as the one last described. As in that species, the front outline of the head is slightly (though only very slightly) sinuous, less even than in *Ph. culebroides*, and the sides of the head are prolonged downward below the eyes as small, somewhat square appressed lobes, but smaller than in that species. In coloration it is similar also, but the body surface is less smooth and is noticeably pubescent with short stiff hairs. The largest specimen is a female bearing a number of large young in the marsupium, which is distended so that it is difficult to see how the animal could have walked. Body length a little over 3.5 mm. There are also two considerably smaller specimens, one a male, one a female, which are evidently immature.

As is well shown by a comparison of the figures of the two species, the body

is broader in the present one, the head narrower and smaller, the abdomen much smaller (unusually small in fact), and more tapering, the telson shorter and more broadly rounded at the tip, and the branches of the uropoda proportionately very short and small.

The antennae in the only adult individual are unfortunately broken off. The smaller specimens have the antennae, which are pubescent and quite long, but as the relative length of the antennae to that of the body varies with age, their length in the adult can only be guessed at and their restoration (in broken lines) in the figure must be regarded as somewhat conjectural in that respect. The first article of the flagellum is quite short and is equaled or a little exceeded by the second, and much exceeded by the third, which bears a terminal bristle. The eyes are well pigmented and have few though large ocelli.

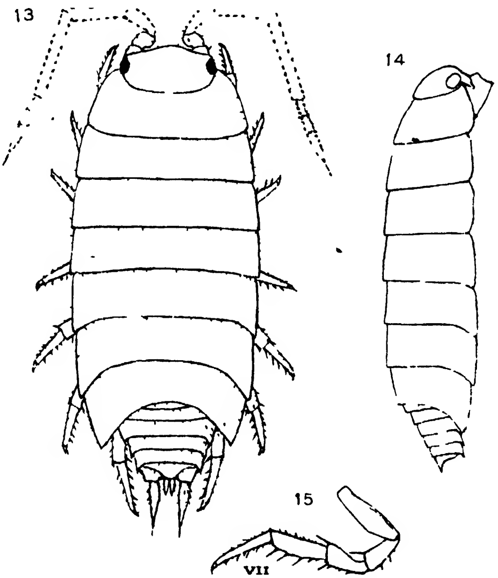

Plate XIII. 13–15, *Philoscia williamsi*, sp. nov. 13 and 14, dorsal view and lateral outline of body of female, × 18. 15, seventh leg × 21.

As compared with *Ph. culebroides* this species has the lateral ends of the last four thoracic segments more squarely cut off and with the angles a trifle sharper. The corresponding angles of the third, fourth and fifth abdominal segments are produced back into more prominent triangular points than is the case in that species.

I was unable to distinguish any special modification of the anterior pair or any pair of legs in the male. Though the immaturity of the specimen may make this observation somewhat inconclusive, it appears, when taken with the resemblances in the head, to support the view expressed above that this form is also a member of the same section of *Philoscia* as *Ph. culebrae* Moore, 1902.

Collector's number of the three specimens 2232. They were collected under lava blocks on Tower Island, April 18th, 1923.

Philoscia nomae, sp. nov.

(Plate XIV, figs. 16–18).

With *Philoscia culebroides*, described above, was a mutilated example of a much broader species, having the body surface very smooth and shining and very long legs with well developed spines. The head and antennae, part of the first thoracic segment, and the uropoda are missing. The specimen is a female. Though it resembles *Ph. williamsi*, just described, in color and in the small tapering abdomen, it differs in the following characters:

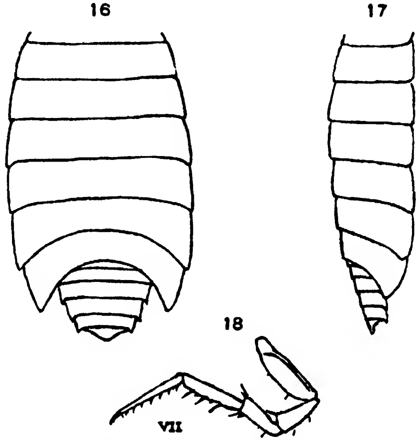

Plate XIV. 16–18, *Philoscia nomae*, sp. nov. 16, 17, outline of body of female, dorsal and lateral views, × 10.2. 18, seventh leg × 12.

Larger size; the specimen if entire would measure about .5 mm. long; much longer and slender legs (compare figs. 15 and 18 representing the seventh legs of each); only the last three instead of the last four thoracic segments have the posterior angles noticeably extended back (their apices are also less sharp than in *Ph. williamsi*); the telson is obtusely triangular, the apex being little rounded off and the sides practically straight. Being a female the specimen gives no information as to possible secondary sexual characters in the anterior legs, and its incomplete condition makes it difficult to determine its nearest relationship, or identify it with any described species, but its position in this genus seems to be evident.

Collector's number 2416. Taken under lava on Tower Island, April 28th, 1923.

Genus (or subgenus of Genus *Porcellio* Latreille, 1804)
Porcellionides Miers, 1877

Stebbing (Rec. Indian Mus. Calcutta, VI, p. 188, 1911) has shown that the commonly accepted name *Metoponorthus* Budde-Lund, 1879, is antedated

by and a synonym of *Porcellionides* Miers, 1877, which must therefore be used for this group whether it be treated as a genus or only a subgenus.

Porcellionides pruinosos (Brandt).

> *Porcellio pruinosus* Brandt, 1833, *Bull. Soc. Imp. Nat. Moscou*, VI, *p.* 19.
> *Porcellio maculicornis* Koch, 1835–1844, *Deutschl. Crust.*, *p.* 34.
> *Metoponorthus pruinosus* Budde-Lund, 1885, *Crust. Isop. Terrest.*, *pp.* 169, 171; Sars, *Crust. Norway*, II, *p.* 184, *pl.* LXXX, *fig.* 2; Richardson, 1905, *Bull.* 54, *U. S. Nat. Mus.*, *p.* 627, *fig.* 674; Racovitza, 1908, *Arch. Zool. Exper. et Gen.* (4) IX, *p.* 386.
> *Porcellionides pruinosus* Stebbing, 1911, *Rec. Indian Mus. Calcutta*, VI, *p.* 189.

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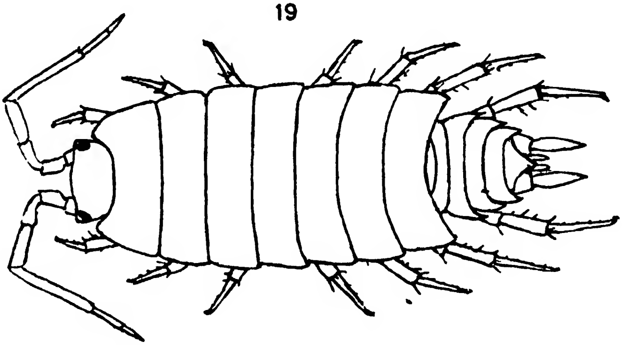

Plate XV. 19, *Porcellionides pruinosus* Brandt, 1833. Dorsal view of female, × 7.5.

(Plate XV, fig. 19).

Many other of the numerous synonyms and references to this species are listed in the above works of Budde-Lund and Richardson.

This species of almost world wide distribution, common in nearly every country in the vicinity of human habitations, hardly needs description here. It is of rather flattened form, the back with slightly developed small granular tubercles. The legs of the posterior part of the body are long and slender, but those of the anterior part are much shorter. The long antennae with a two-jointed flagellum in which the proximal joint is long and slender, and the terminal one considerably shorter, are one of the most conspicuous characters by which the species may be recognized.

Six specimens (the largest a female only about 8 mm. long and probably not fully grown) were obtained by the Galapagos Expedition.

Five specimens (Collector's numbers 2403, 2416, 2471) were taken in April, 1923, on Tower Island; one specimen (number 2306) was collected on Indefatigable, April 22nd, 1923. All were found resting motionless on the underside of lava slabs.

Genus *Rhyscotus* Budde-Lund, 1885

A small but widely distributed group of very small isopods distinguished by the great bulbous enlargement of the epistome which is well marked off from

the rest of the head, and the very wide, short maxillipeds which have the palp and molar portions also very wide and proportionately short. For a diagnosis and synopsis of the genus see Budde-Lund, 1906, in Voeltzkow, Wiss. Ergeb. Reise in Ostafrika, II, p. 298 ff. That author has made it the type and only genus of a subfamily (Rhyscotinae) of the Oniscidae, and in the above work divides it into two sections, to which however he does not assign names. *Hypergnathus* Richardson, 1905, is regarded by him as insufficiently distinguished from *Rhyscotus*. It is based on a species from Texas.

Rhyscotus laxus, sp. nov.

(Plate XVI, figs. 20-22).

Body long and narrow, and moreover so loosely articulated that considerable motion of the segments in a longitudinal direction is possible, while the soft integument permits of a varying degree of lateral spread of the free lateral ends of the segments. The illustration here given shows the segments quite closely approximated, so that, seen from above, the outline is that of a long narrow ellipse. Many of the preserved specimens are more relaxed and longitudinally extended, so that they exhibit a more parallel-sided outline.

Body surface evenly, but not very thickly, covered with short hairs or setæ, visible only on considerable magnification. The antennae, uropoda and legs are also more or less setose. Along the free borders of the segments the setae are a little longer and stouter and form a regular row, closer together than on the general surface of the body.

In the alcoholic specimens, the back, excepting a border along the free margins of the segments, an irregular area of variable but considerable extent near each lateral end of each segment of the thorax, also numerous smaller oval spots on the median parts of the thoracic segments and on the head, is slaty gray; below considerable gray pigment is also found on the maxillipeds, first thoracic legs, and on the abdominal segments and pleopoda, except the first pair; the antennae are also quite deeply pigmented above and below, except the second and third joints. Most of the under parts and limbs and the entire uropoda, both above and below, as well as the above mentioned spots and areas on the back, are unpigmented, appearing whitish or translucent with little or no tinge of yellow. There is much individual variation in the relative extent of the pigmented and unpigmented parts.

The length of the largest specimens ranges from 4.25 to about 5 mm., depending on the degree of relaxation of the muscles and consequent extension of the intersegmental membranes. This also causes the length-to-width ratio to vary greatly.

Head considerably narrower than the first thoracic segment into which it is rather deeply set back. A nearly straight transverse furrow marks off the epistome from the main or posterior part of the head. The latter is produced downward and a little forward into an obtuse lobe on each side below the eyes, which have few, apparently usually about 10, well developed ocelli. The epistome forms a large rounded projecting bulbous expansion of the anterior median part of the head between the sockets of the second antennae. It is covered, like the rest of the body and head, with scattered short setae and shows

on careful examination a number of very faint transverse furrows on its anterior aspect, but these are so shallow and poorly marked as to easily escape notice altogether. The second antennae are long and stout, the flagellum is long and composed of two articles, the first being considerably the shorter. The mouth appendages form a prominently projecting mass.

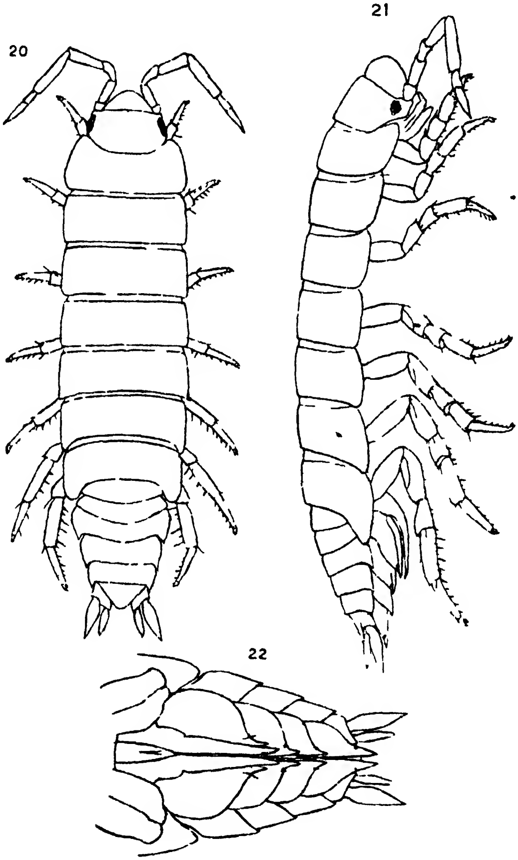

Plate XVI 20–22, *Rhyscolus laxus*, sp nov 20, 21, dorsal and lateral views of female, × 16 and 18 respectively. 22, ventral view of abdomen of female, × 21

The thoracic segments vary comparatively little in length. Their lateral ends are cut off in the arc of a large circle; only the last three have their posterior lateral angles noticeably extended backward, this occurring to a rapidly increasing degree from the fifth to the seventh. The first three have the posterior lateral angles broadly, the others quite narrowly rounded off. The portion of each segment that fits under the segment in front of it is slightly but quite abruptly lower than the rest, the change of level being marked by a noticeable

line. The legs are, in proportion to the slenderness and small actual bulk of the body, rather long and large. They are more or less setose, but their spination is rather weakly developed. The first pair are stouter than the two next pairs but exhibit no special modification. The dactylus of all the legs ends in a very minute claw on the lower side of which is a minute vesicle-like pad that is usually in a more or less collapsed condition in these specimens.

The abdominal segments except the first two have the posterior angle produced back into a small acute point. The telson is triangular with straight converging sides and a rounded tip. Excepting one very minute individual whose peculiarities are evidently due to immaturity, the specimens all have pleopoda with outlines like those shown in the figure, the first pair being long, narrow and sharply pointed, while the others all have a more or less acutely pointed median posterior angle, especially those of the fifth segment. Long, narrowly produced pleopoda are found in the males only in most terrestrial isopods, but many of these specimens are certainly females, having marsupial plates under which (usually one under each plate) eggs or embryos are carried. These plates are of squarish outline and overlap very little at the median line, hence they are not very conspicuous. I am not certain whether or not any of the specimens are males, for although some lack the marsupial plates, and differ in their somewhat smaller size and in having the first joint of the peduncle of the antennae much shorter than the second, possibly these differences are to be attributed to immaturity or sterility instead of to sexual difference. The above peculiarity of the first pleopoda and the comparatively inconspicuous marsupial plates may explain Budde-Lund's failure to recognize females (except one mutilated individual lacking the entire posterior part of the body and hence also the pleopoda) among the specimens of this genus that he examined.

Collectors' numbers of the specimens obtained:

2297—15 specimens, sifted from dead leaves, South Seymour, April 22nd, 1923.

2403— 1 specimen (female, type), under lava, Tower Island, April 27th, 1923.

2416— 1 specimen, under lava, Tower Island, April 28th, 1923.

2471— 3 specimens }
2422— 3 specimens } under lava, Tower Island, April 29th, 1923.

This form belongs to the first of the two sections into which Budde-Lund (1906, in Voeltzkow, Wiss. Ergeb. Reise in Ostafrika, II, pp. 299, 301) divides the genus *Rhyscotus*. The species comprising it are distinguished by having the telson triangular with straight (not concave) sides, the thoracic legs terminated with a very small claw beneath which is a vesicle-like pad, and the basal segment of the uropoda equal in length to the inner branch it bears. To these characters this species conforms. Budde-Lund in his synopsis enumerates four species in this section. The present one differs from *R. parallelus* from Venezuela (see Dollfus, Ann. Soc. Entom. France, LXII, p. 342, Pl. IX, figs. 6–6*d*) in the front of the epistome showing only very faintly indicated transverse furrowing and in the lobes of the head in front of the eyes being less acute and prominent, and from *R. ortonedae* from Equador (Budde-Lund, 1906, op. cit., p. 299, Pl. XVII, figs. 11–31) in the much less globular epistome and more

angular outlines of the body segments as seen in a lateral view. From *R. linearis* from the Comoro Islands (Budde-Lund, 1906, op. cit., p. 300, Pl. XVII, figs. 32, 33) a very incompletely described form, the present one would seem to be distinguished by the less broadly rounded lateral angles of the segments, a slightly broader telson, and by not having the setae on the borders of the segments conspicuously large, though as a matter of fact they are little longer than those scattered over the body surface. The widely separated localities are against their identity also. The fourth species of the section, *R. cubensis* (Budde-Lund, 1906, op. cit., p. 300) from Cuba, very briefly described from a single mutilated specimen comprising only the head and four body segments, is said to have the rear border of the third and fourth thoracic segments "in medio leviter incurvo," while in this species the border is straight or even very slightly convex. It therefore seems necessary to consider this form as new.

Genus *Cubaris* Brandt, 1833

Cubaris galapagoensis Miers.

> *Cubaris galapagoensis* Miers, 1877, *Proc. Zool. Soc. London*, 1877, *p.* 74, *pl.* XII, *figs.* 2–2c.
> *Armadillo galapagoensis* Budde-Lund, 1885, *Crust. Isop. Terrest.*, *p.* 40; 1904, *Rev. Crust. Isop. Terrest.*, *pt.* III, *p.* 108.

(Plate XVII, figs. 23–27).

This species was described by Miers from a single specimen 11 mm. long, collected in 1875 at Charles Island by the expedition under Commander W. E. Cookson. The present collection contains also only a single specimen, a male, considerably smaller than the original one, though in its rolled up condition it cannot be accurately measured. Miers' description being brief, and in some respects vague, the following details are given here.

Body seen from above oblong, narrowly rounded behind; in front the outline of the head forms a curve only gently arched. Body hard and compactly articulated; its surface minutely granular under magnification and raised also into rounded and elongate tubercles arranged with some regularity. These form a well defined transverse row along, though a little removed from, the posterior margin of each thoracic segment. In each of these transverse rows about six of these tubercles occupying the median region are small and rounded, those in the dorso-lateral parts (about four on each side) are larger and more elongate; at the junction of the main and epimeral portion of the segment there is a single somewhat elongate one, and on each epimeron a single obliquely placed one. A few smaller, less well defined tubercles occur in front of this row on the median portion of each segment, and on the first segment, which is much longer than the others, there are additional elongate ones and a pair of exceedingly large ones close together, one each side of the median line on the anterior part of the segment. The forehead bears a number of small tubercles. The surface of the abdomen is practically smooth except for a tubercle on each epimeron of the third, fourth and fifth segment, a pair on the anterior part of the telson, with a poorly defined one somewhat asymmetrically placed behind or below this pair. Whether this represents a somewhat misplaced median

tubercle or one of a pair the other of which is not developed, I do not know. The specimen cannot be straightened out without danger of breaking it, but would probably not much exceed 6 mm. in length. The color in alcohol is rather dark gray above with the margins of the segments and the tubercles

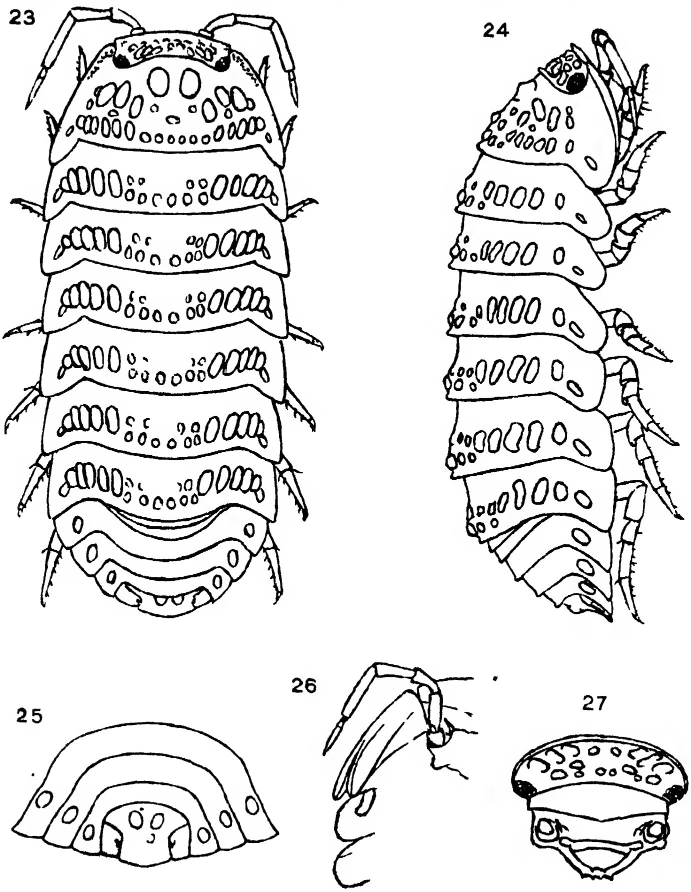

Plate XVII 23-27, *Cubaris galapagoensis* Miers, 1877. 23, 24, dorsal and lateral views of male, × 14 25, rear end of body, × 19. 26, ventral side of anterior segments, × 15 5 27, front view of head, × 17.5.

light grayish or brownish white (unpigmented), as are also the legs and most of the under parts. Head only moderately wide, eyes small with about 15 ocelli. Upper edge of epistome gently arched when seen in an anterior view, and forming a narrow projecting border clear across the head. Antennae of moderate length and quite slender; the flagellum is slender, shorter than the last joint of the peduncle, and consists of two articles, the basal one about one-third the length of the second or terminal one.

Thoracic segments having their exposed part noticeably (but not very abruptly) raised above the part fitting under the next segment in front, and the rear border forming a somewhat prominent ridge. Their rear lateral angles are considerably produced backward, and except the last three, conspicuously rounded in outline. The first segment has the lateral border curved as seen in a side view, and its anterior two-thirds are rolled outward to form a prominent but not very thick projecting margin. No distinctly defined groove marks this off from the lateral face of the segment. The rear lateral angles have a small nearly equal-sided cleft to receive the second segment when the body rolls up; this is not continued forward into a perceptible sulcus on the underside of the rolled out margin except for a short distance. The second segment bears a small, short, rather bluntly pointed coxopodite process between which and the inner face of the epimeron the inner division of the cleft rear angle of the first segment fits when the body rolls up. The third segment merely has the anterior border of the epimeron thickened, but bears no process. The legs are only moderately long, rather weak and not very spiny. The abdomen has the lateral ends of the segments squarely truncated and slightly flared outward. The telson is somewhat broader than long in its upper portion; its terminal border, which is somewhat convex, projects a trifle beyond the outline formed by the other abdominal segments and is nearly two-thirds the width of the upper part. The middle portion is a little constricted. The exposed parts of the basal joints of the uropoda are longer than wide. Their inner branches (seen only in a ventral view) are exceedingly short; the outer branches are reduced to minute rudiments, short and thick, each borne on a small tubercle close to the inner margin of the outer face of the basal joint, some distance from the rear margin.

The specimen was found under a stone on Eden Island.

Cubaris beebei, sp. nov.

(Plate XVIII, figs. 28–30).

Body oblong when seen from above, the front outline of the head and first segment, and that of the abdominal segments and uropoda, forming broadly rounded curves in front and behind. Back highly arched, its surface without any coarse tuberculation (though very slightly uneven in the dorso-lateral regions), but under considerable magnification it exhibits evenly, though not very thickly distributed scabrous punctations. Color gray-brown above with the usual light markings; legs and under parts not pigmented. Length of the largest specimens, which are perhaps not fully grown, about 5 to 6 mm.

The exposed part of each thoracic segment is somewhat elevated (though not abruptly so) above the part overlapped by the segment next in front. Their posterior lateral angles are but little extended backward, those of the first three or four are rounded; the other segments become successively more squarely truncated proceeding toward the rear.

Upper margin of the epistome only very gently arched and turned up to form a very narrow but distinct projecting border clear across the front of the head. This border is separated from the forehead by a very narrow impressed groove or furrow. Eyes rather small, with about 12 ocelli. Second antennae rather short and small, their flagellum is two-jointed; the basal joint is only about one-third that of the terminal one in length.

Lateral border of first thoracic segment turned obliquely up (rather widely in front, the reflected part diminishing to nothing as the rounded rear angle of the segment is approached) so as to form between itself and the surface of the main part of the segment a narrow shallow groove. Posterior lateral corner of the first segment with a small cleft, but this is not extended forward as an appreciable sulcus on the inferior aspect of the margin except for an insignificant

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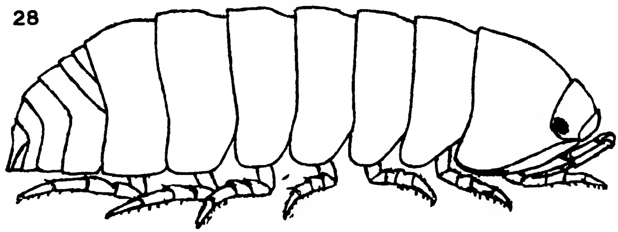

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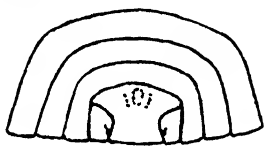

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Plate XVIII 28–30, *Cubaris beebei*, sp. nov 28, side view of female × 15 5. 29 rear end of body, × 20 30, ventral side of anterior segments, × 17.5.

distance. The epimeron of the second segment bears on its inner aspect a small coxopodite process ending in a flattened bluntly rounded tip. No processes on the third segment. Legs rather small and weak, their spines rather few and small.

Lateral ends of the third to fifth abdominal segments truncated and forming a smooth continuous outline with the basal segments of the uropoda and telson. They are not noticeably bent or flared outward.

Telson broader than long by nearly one-fourth and considerably constricted in the middle; the truncated rear end is about two-thirds the width of the upper part. On the middle line near the upper end there is an elongate depression or shallow pit with a slight elevation on either side.

Basal segments of uropoda a little longer than wide. Their inner branches, visible only from below, are very short and rather wide; the outer branches are reduced to very small rudiments borne close to the inner margin (that next to the telson) of the basal joint, some distance from the rear end.

Eight specimens, representing individuals of both sexes, are in the collection. Three of them have the collector's number 2297 and were taken in siftings of dead leaves on South Seymour, April 22nd, 1923. The others (including the type) are labeled "Under stones, Eden." One of the largest females has been selected as the type.

This species is very closely related to several of those already described from the warmer parts of America, but most closely of all to *C. grenadensis* (Budde-Lund), 1893, Entomol. Meddel., ann. 1893, p. 115, from Grenada, W. I., also described briefly and somewhat crudely figured by Dollfus, 1896 (Proc. Zool. Soc. London, ann. 1896, p. 392, figs. *5a–5d*), who records it from two additional islands (Becquia and Balthazar) of the West Indies. I cannot however regard the two forms as identical.

In *C. grenadensis* the sulcus on the inferior margin of the first segment is considerably better developed, reaching half the length of the border before fading out, the body surface is "minutissime et densissime reticulate punctata" according to Budde-Lund, which would hardly be correctly applied to the rather scattered scabrous punctations of the Galapagos form; the upper margin of the epistome is described as "in medio levissime, vix memorabiliter reflexo," while in the Galapagos specimens it is nearly as much reflected at the center as at the sides and has a decidedly more convex outline as seen from above or below than the figures of Dollfus indicate is the case in the West Indian species. His figure also shows the inner branch of the uropoda much longer and narrower than in the present specimens, and the size is much larger (14 mm. long) according to Dollfus. From another closely related species, *C. dugesi* (Dollfus), 1896, from Mexico, the form of the telson serves as a distinguishing character, as in that form it is as long as wide. *C. pisum* (Budde-Lund), 1885, from Florida, is distinguished by its much longer antennae and moreover has the minute outer branch situated near the end ("apice propius") of the basal joint of the uropod. *C. dumorum* (Dollfus), 1896, from Mustique Island, W. I., has the coxopodite process of the second segment large and square. *C. vincentis* (Budde-Lund) syn. *C. cincta*, *C. perlata* and *C. silvarum*, all described by Dollfus (1896) from the West Indies, as well as *C. galapagoensis* Miers, 1877, redescribed above in this paper, are all near allies of the present form, but distinguished either by the tuberculation of the body surface or by the much greater length of the sulcus on the margin of the first segment of the thorax (in the case of *C. perlata* by both these characters).

Family LIGYDIDAE

Genus *Ligyda* Rafinesque, 1814 (= *Ligia* auct. plur.)

Ligyda baudiniana (Milne-Edwards).

Ligia baudiana Ives, 1891, *Proc. Acad. Nat. Sci. Philadelphia*, *p.* 185, *pl.* VI, *fig.* 2.

Ligia baudiniana Milne-Edwards, 1840, *Hist. Nat. Crust.*, III, *p.* 155; Saussure, 1858, *Mem. Soc. Phys. Hist. Nat. Genève*, XIV, *p.* 476; Stuxberg, 1875, *Öfvers. K. Svensks. Vetensk.-Acad. Forh.*, XXXII, *No.* 2, *pp.* 43, 46, 48; Ives, 1891, *Proc. Acad. Nat. Sci. Philadelphia*, *pp.* 199, 200; Richardson, 1901, *Proc. U. S. Nat. Mus.*, XXIII, *p.* 574; 1902, *Trans. Connecticut Acad. Sci.*, XI, *p.* 306, *pl.* XL, *fig.* 61; 1904, *Proc. U. S. Nat. Mus.*, XXVII, *pp.* 24, 30; Chilton, 1916, *Mem. Indian Mus. Calcutta*, V, *pp.* 464, 466, 472, 473; Jackson, 1922, *Proc. Zool. Soc. London*, *pp.* 689, 698, *pl.* II, *figs.* 17, 18.

Ligia exotica (not Roux, 1828) + *L. exotica* var. *hirtitarsis* Dollfus, 1890, *Bull. Soc. Études Sci. Paris*, XII, *p.* 7, *figs.* 5, 6.

Ligia hirtitarsis Dahl, 1892, *Ergeb. Plankton-Exped.*, I, *pt.* 1, *p.* 111, *pl.* III, *figs.* 1, 6, 7, 11, 12.

Ligia gracilis Moore, 1902, *Rept. U. S. Comm. Fisheries*, XX, *part* 2, *p.* 175, *pl.* XI, *figs.* 7–12.
Ligyda baudiniana Richardson, 1905. *Bull.* 54, *U. S. Nat. Mus.*, *p.* 678, *figs.* 719–723.

The following references appear to apply to this species more or less doubtfully:

Ligia baudiana Miers, 1877, *Proc. Zool. Soc. London*, *pp.* 670, 671.
Ligia baudiniana Bate, 1868, *Ann. Mag. Nat. Hist.* (4) I, *pp.* 443, 446.

(Plate XIX, figs. 31–36).

The Galapagos collection contains specimens which I am unable to separate specifically from this species inhabiting the West Indian region and Atlantic coast of America from Florida to Rio Janeiro, although not reported on the Pacific side. The largest specimen (fig. 31) from the Galapagos has more elongate antennae, which reach to or beyond the end of the body, and longer uropoda than are credited to this species in the descriptions except in the somewhat doubtful one of Miers, 1877, (which may refer to another species, *L. exotica* Roux, 1828), but few museum specimens have these parts (especially the uropoda) attached and complete, so that we actually have very little information as to how long these parts normally become in *L. baudiniana*, although the specimens available show that there is considerable variation individually and with age. Under these circumstances I cannot base a specific distinction on this character.

In its general form and character this species resembles the well known and widely distributed *L. exotica* (Roux), 1828, but is distinguished by its smaller size, somewhat wider head and more elongate eyes, its obtusely ending telson, the more complete fusion of the epimera with the main portion of the thoracic segments, and especially by the first legs of the male, which lack the small lateral process at the distal end of the propodus that is present in *L. exotica* but have the merus and carpus flattened and provided on the thin inferior borders with a single row of short, close-set spiny hairs. These joints are also provided with a file-like area of fine, parallel, obliquely transverse ridges and furrows on their anterior aspect. The second and third legs have the corpus swollen and provided with a narrow file-like area, but the fringe of spiny hairs is present only on the first pair. In the female the three anterior legs are similar to the fourth and the more posterior pairs which are alike in both sexes.

Some other particulars not shown in the accompanying figures are as follows:

The body surface is covered with scattered, very small, low tubercles; slightly larger ones form a row along the rear edge of the segments. The color is greenish gray, due to minute, thickly but unevenly scattered, irregularly stellate pigment spots.

The largest male and female (13.5 and nearly 12 mm. long respectively) have antennae reaching beyond the end of the body when drawn back and having 43 or 44 articles in the flagellum. The smaller specimens have the antennae proportionately much shorter (not reaching much beyond the end of the thorax) and with fewer articles (sometimes less than 30). The uropoda were lost except in two specimens. In the large male they are long, the basal

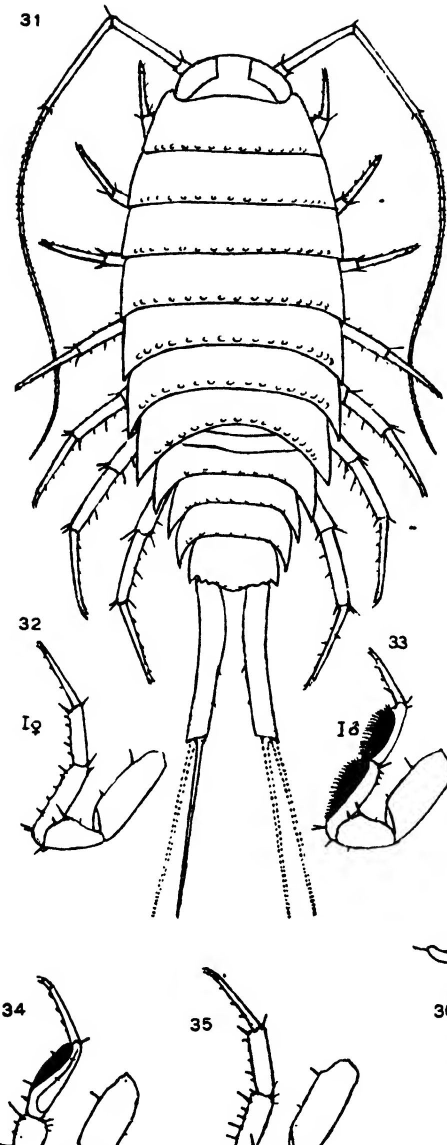

Plate XIX. 31–36, *Ligyda baudiniana* (Milne-Edwards), 1840. 31, dorsal view of female, × 6.4. 32, first leg of female × 8.4. 33, first leg of male × 7.2. 34, second leg of male × 7.2. 35, second leg of female × 8.4. 36, styloid process of right second pleopod of male, ventral view, × 12.

joint almost equaling the exposed part of the abdomen measured on the median dorsal line, and the inner branch (the outer is missing in both cases) considerably exceeding the basal joint in length. In one of the smaller specimens the uropoda are, however, proportionately much shorter. I have compared the stylets of the second pleopoda in males of the Galapagos and West Indian specimens and find them closely similar, but they are very different from those of *L. exotica*, which have the ends enlarged and rounded. In *L. baudiniana* the organ tapers to a not very acute tip which is twisted slightly inward toward the median line. The ventral surface bears a shallow groove along the entire length of the stylet. This groove has its outer margin more prominent than the inner. From a small cleft on the dorsal surface near the distal end, a tapering flexible fleshy process of varying length protrudes.

Six specimens are in the Galapagos collection. Collector's numbers:

2471—3 small specimens (not adult).

2232—1 male.

2416—1 female.

These were all taken under lava blocks on Tower Island, in April, 1923.

Conway Bay, Indefatigable Island, April 1, 1923. One male (largest specimen).

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

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PARASITIC COPEPODS[1]

FROM THE WILLIAMS GALAPAGOS EXPEDITION

By Charles B. Wilson

(Plate XX).

The seventh expedition of the Department of Tropical Research of the New York Zoological Society was known as the Williams Galapagos Expedition. They visited the little group of islands named, which have become biologically famous, and Mr. William Beebe, who acted as Director of Scientific Work, collected quite a number of parasitic copepods. These were forwarded to the present author with the request that they be identified and such notes added as might be of interest. So little is known of the copepod fauna of that region that even a bare list of the species obtained would be well worth publication. In the present instance also the species are themselves of considerable interest and their presence here on the equator in the Pacific Ocean greatly modifies our previous knowledge of their distribution.

Caligus parvus Bassett-Smith.

A single female was obtained from the outside surface of a large brown grouper at Conway Bay, Indefatigable Island, April 1, 1923. The only previous record of this species was made by Bassett-Smith who obtained both sexes from a puffer in Bombay Harbour, India. He said of them . . . "They were often seen actively moving about, and were of a pinkish color, both sexes being equally common." The present specimen still retains in the preservative a decided pinkish hue.

Lepeophtheirus dissimulatus Wilson.

Fifteen specimens, including both sexes, were taken in company with the preceding species upon the same grouper. This species has been found twice before, the original type specimens being taken from a white-spotted serranus, *Epinephelus labriformis*, at Charles Island, another of the Galapagos group. A second lot was obtained from the red grouper, *Epinephelus morio*, at the Bermuda Islands in 1903. These two lots, together with the present one, indicate that the species is fairly common upon the groupers of both the Atlantic and Pacific Oceans in the tropics.

Caligus irritans Heller.

A single female was taken from the mouth of a large-eyed blue fish in Conway Bay, Indefatigable Island. This species was originally described by

[1]Cont. Department, Trop. Research No. 185.

First form on press December 15, 1924

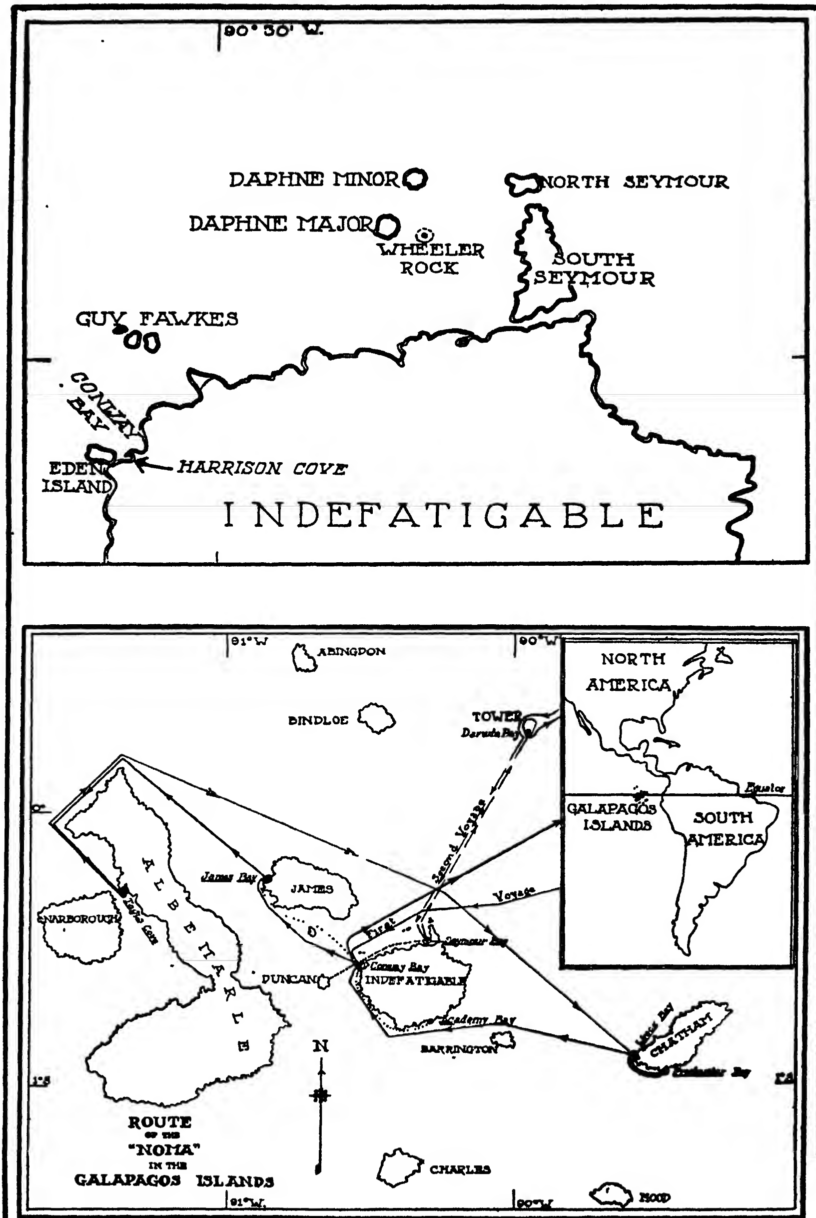

Plate A. SKETCH MAP OF GALAPAGOS ISLANDS
Route of the *Noma*, and details and location of the Archipelago.

Heller from specimens taken from the gills of a grouper off the coast of Brazil. Both sexes were also found by the present author upon the gills of the red-mouthed grunt and the crevalle at Jamaica in the West Indies. This specimen from the Galapagos Islands indicates that the species may be looked for in the tropics of both oceans.

Pandarus satyrus Dana.

Three females and a male were taken from the outside skin of a nine-foot shark captured at night in Seymour Bay, Indefatigable Island. Another female was found upon the skin of a six-foot shark at Tower Island. This parasite had worn a rather deep depression into the skin of its host. A single female was also taken from the outer skin of an eight-foot shark at Seymour Bay, Indefatigable Island. Dana's original type specimens came from a large shark captured south of Tongatabu, one of the Friendly Islands. The U. S. National Museum contains a single lot of 15 females taken from the sides and pectoral fins of a blue shark, *Prionace glauca*, at the Hawaiian Islands. The male was first described from two specimens taken from a large shark in the tropical Atlantic. It seems to be a very common parasite at the Galapagos Islands.

Paralebion elongatus Wilson.

Three females and two males were taken from a nine-foot shark at Indefatigable Island. The types of this species were obtained from a shark caught in Chesapeake Bay in the summer of 1910.

Nessipus costatus sp. nov.

(Plate XX, figs. 9–16).

Host and record of specimens.—Two females without egg strings and one male were taken from a nine-foot shark at Indefatigable Island, April 21, 1923. There is no record of the part of the body of the host, upon which they were found, but if we may judge from the records of other species of this genus the male was probably found on the outside surface or fins, while the females came from the throat or gill cavity. *Costatus*, ribbed, alluding to the frontal plates.

Specific characters of female.—Carapace nearly orbicular, a trifle wider than long; lateral areas of medium width; posterior lobes short, wide and bluntly rounded; cephalic area large; frontal margin evenly rounded, with a small incision at the center; frontal plates wide and distinctly ribbed transversely, a very distinctive character.

Second and third thoracic segments fused and furnished with a single pair of lateral plates, well rounded and reaching behind the posterior lobes of the carapace; no dorsal groove indicating the line of separation between these segments; posterior margin of third segment three-lobed. Fourth segment contracted anteriorly but not forming a neck as in the following species; its two dorsal plates fused with no indication of their dual origin, the combined plate slightly wider than the genital segment and without a trace of a posterior invagination.

Genital segment one-half longer than wide, with straight parallel sides and broad evenly rounded lobes at the posterior corners; posterior invagination wide

and shallow, showing the abdomen; the latter is one-jointed and its posterior margin just reaches the tips of the posterior lobes on the genital segment; anal laminae fairly large, each armed with four plumose setae.

First antennae of the usual pattern; second pair long and slender, with a pad at the base but none on the second joint, the terminal claw without accessory spines. First maxillae similar to those of other species but more evenly rounded, with two small spines at the tip and a minute palp armed with three tiny spines. Second maxillae without accessory spines on the second joint and at the tip. Maxillipeds without a claw but with wart-like processes shutting together as in some species of Pandarus. Swimming legs as in other species, the first pair with five spines on the outer margin of the terminal joint of the exopod, the fourth pair with three spines on the outer margin of the exopod; these spines all taper to a sharp point.

Specific characters of male.—Carapace elliptical, longer than wide, with narrow lateral areas and a large cephalic area; posterior lobes curved inward at their tips; frontal margin more convex than in the female, with a slit-like central invagination; frontal plates distinctly ribbed as in the female; two small elliptical lenses, transparent and placed diagonally just behind and on either side of the tripartite eye. Second, third, and fourth segments about the same length but diminishing regularly in width, the last one wider than the genital segment and nearly twice as wide as long. Genital segment one-fourth wider than long, with prominent conical lobes at the posterior corners. Abdomen one-jointed; annal laminae small and angular, each armed with four plumose setae a little larger than those on the female. Antennae, mouth parts, and legs similar to those of the female.

Color (preserved material).—Both sexes a uniform yellowish-white.

Total length of female 5 mm., of male 4 mm. Carapace of female 2.80 mm. wide, 2.60 mm. long. Carapace of male 2.30 mm. wide, 2.50 mm. long.

Remarks.—The conspicuous transverse ribs of the frontal plates furnish the distinctive character which is the easiest to recognize, but the general makeup of the body and the details of the appendages are considerably different from those of other species.

Nesippus occultus sp nov.

(Plate XX, figs. 1–8).

Host and record of specimens.—One female and nine males were taken from a nine-foot shark at Indefatigable Island, April 21, 1923. As with the preceding species no statement was made in regard to the location of the specimens upon the shark's body. Usually in this genus the males frequent the outside surface while the females are found in the mouth or throat. Ordinarily also only one or two females are found upon a single shark and this would explain somewhat the disparity in the specimens of the two sexes. *Occultus*, hidden, alluding to the abdomen.

Specific characters of female.—Carapace transversely elliptical, one-eighth wider than long; frontal plates distinct and relatively very narrow; frontal

margin evenly rounded without any incision at the center; posterior lobes short, wide, and rather pointed; lateral areas narrow for this genus, cephalic area large.

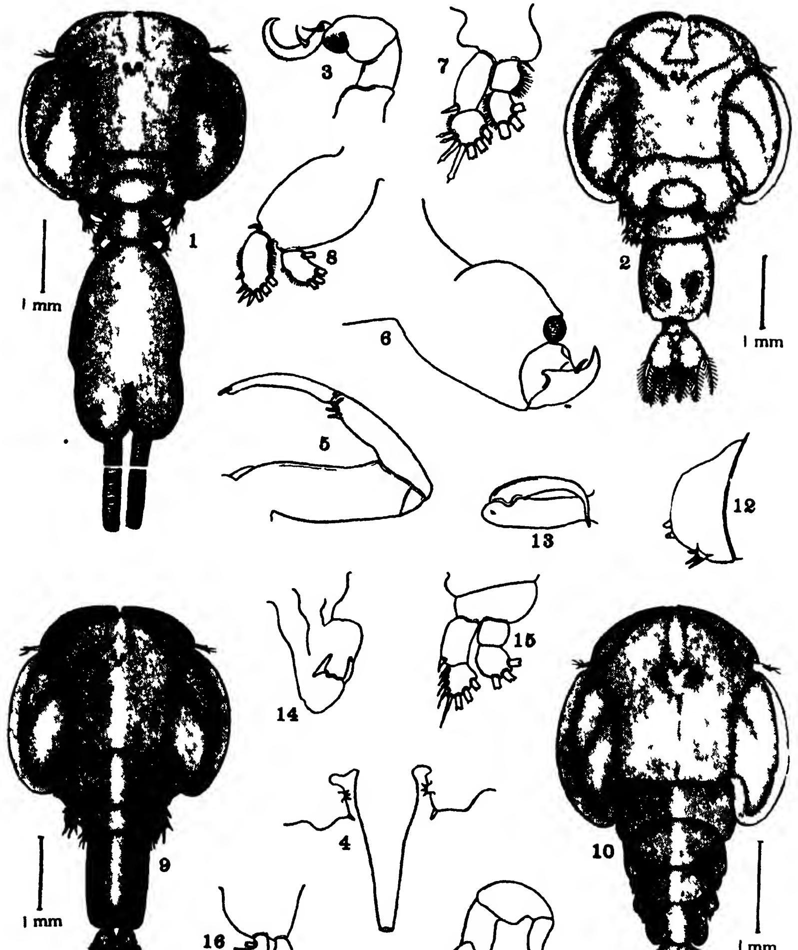

Plate XX. 1, *Nesippus occultus*, dorsal surface of female; 2, dorsal surface of male; 3, second antenna; 4, mouth tube and first maxillae, the latter not in their normal position (see text); 5, second maxilla; 6, maxilliped; 7, first leg; 8, fourth leg; 9, *Nesippus costatus*, dorsal surface of female; 10, dorsal surface of male; 11, second antenna; 12, first maxilla; 13, second maxilla; 14, maxilliped; 15, first leg; 16, fourth leg.

Second and third thoracic segments fused as usual, with only a single lateral plate on either side, but with a fairly distinct dorsal groove between the segments. Fourth segment contracted into a narrow neck anteriorly and expanded posteriorly into a pair of dorsal plates, which are about half the width of those on the second and third segments. Here again the two are so thoroughly fused as to give no evidence of their dual origin either by a longitudinal dorsal groove or by a posterior sinus on the midline.

Genital segment elongate elliptical, twice as long as wide, with the lateral margins somewhat evenly rounded and with a deep posterior sinus, one-fourth of the entire length of the segment; posterior lobes broadly and evenly rounded, overlapping slightly on the midline. Abdomen and anal laminae entirely concealed, the former wider than long with parallel sides, the latter rather large and somewhat triangular, each armed with four plumose setae. Egg strings narrow and twice the length of the body.

First antennae like those in other species; second pair relatively large with a small adhesion pad on the ventral surface at the base of the terminal claw. The latter is large and curved into a half circle, with the concave surface flattened and armed with a row of minute teeth along either margin and with two setae near its proximal end. First maxillae short and wide laminae, more or less angular, with a single short spine at the tip and near the center of the inner margin a minute palp tipped with three tiny spines. These laminate maxillae stand on edge, projecting from the ventral surface parallel with each other. In the figure (4) here given they were cut loose from the ventral surface of the head, the posterior portion of each was turned outward away from the mouth tube, and they were turned onto their sides in order to show their shape. Second maxillae long, the basal joint quite stout, the terminal portion slender and apparently jointed at the center. There are two small spines at the distal end of the basal portion on the inner surface and a tiny claw at the tip of the terminal portion, attached like a fingernail.

This female was evidently securely attached to her host, since one maxilliped was pulled off and the tip of the other was broken. Enough was left, however, to indicate that the maxillipeds of the female are like those of the male. The swimming legs are like those of other species of the genus, but each of the spines on the terminal joint of the exopod of the first legs is swollen at the end, and is tipped with a minute secondary spine.

Specific characters of male.—Carapace relatively wider than in the female and with a slight median incision on the frontal margin; lateral areas also wider, cephalic area the same. Thoracic segments like those of the female with the second and third segments distinctly separated; fourth segment contracted anteriorly into a neck shorter and wider than in the female. The posterior expansion of this segment is no wider than the anterior portion of the genital segment, while in the female it projects considerably on either side.

The genital segment is quadrangular with nearly parallel sides, the posterior corners produced into minute spines, the posterior margin with a convex double curve. Abdomen one-jointed, two-fifths of the width of the genital segment; anal laminae very large, each of them being twice the area of the abdomen and armed with four large plumose setae.

The antennae and mouth parts are like those of the female. The terminal joint of each maxilliped is much swollen until it is as wide as, or wider than, long. It is tipped with a stout claw, strongly curved and armed with a secondary spine near the center of the concave margin. Opposite the base of the claw is a spherical knob over which the tip of the claw shuts down tightly. The surface of this knob is corrugated and anything like a fold of skin, caught between the claw and the knob, is held as if in a vise.

Color (preserved material).—Both sexes a uniform yellowish-white, tinged with brown over the reproductive organs; egg strings light brown.

Total length of female, 6 mm., of male, 5 mm. Carapace of female, 2.60 mm. long, 3 mm. wide. Carapace of male, 2.50 mm. long, 3 mm. wide. Genital segment of female, 2.80 mm. long, 1.50 mm. wide. Genital segment of male, 1 mm. long, 1 mm. wide.

Remarks.—This species resembles Heller's *Nesippus crypturus* more nearly than any other of the described forms, but shows the following specific differences. In *crypturus* the fused second and third thoracic segments are contracted posteriorly into a neck of the same width as that of the fourth segment; here there is no neck at all on the third and fourth segments. In *crypturus* the fourth segment is about the same width and length; here it is twice as wide as long. In *crypturus* the terminal claw of the second antenna is but slightly curved and its lateral margins are smooth; here it is bent into a half circle and each lateral margin is armed with a row of fine teeth. In the second maxilla Heller's species showed a single spine on the outer margin of the second joint at the distal end and the terminal claw tapered to a sharp point. Here there are two spines on the inner margin of the second joint near the distal end, and the terminal claw is bluntly tipped with an accessory spine attached like a toenail.

The types of both these new species of *Nesippus* are deposited in the Department of Tropical Research of the New York Zoological Society.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

COLEOPTERA[1]

FROM THE WILLIAMS GALAPAGOS EXPEDITION

BY ANDREW J. MUTCHLER

(Figs. 42–46 incl.)

The first records of Coleoptera from the Galapagos Islands were based on specimens collected by Charles Darwin while on the famous 'Beagle' Expedition. There were twenty-nine species in the series, one of which was described as new by the Reverend F. W. Hope (1837). The remainder were reported on by Mr. George R. Waterhouse (1845). He erected three new genera for forms which could not be placed in the then known genera and described twenty-two species as new. Of the other six species he made the following remarks: "But four species amongst the Galapagos Coleoptera occur, so far as I have been able to ascertain, in any other quarter, and of these, two (*Dermestes vulpinus* and *Corynetes rufipes*[2]) are insects which, feeding upon dried meat and such substances, have been carried to all parts frequented by ships; the third is a wood feeding insect (genus *Apate*), and might be transported for a considerable distance by floating timber; and the fourth is a water-beetle which appears to me clearly identical with *Hydrophilus lateralis* (genus *Tropisternus* of Solier), an insect found in the United States, Mexico, and some of the West Indian islands. I should observe, moreover, there is in the collection a second, minute, species of *Hydrophilus* closely resembling the *Philhydrus affinis* of our English collections, but which is rather smaller, less distinctly punctured, and of a darker hue." The above refers to five of the species; of the sixth, which is a staphylinid, he says: "Three specimens found under a dead bird in Chatham Island. These specimens approach very nearly in size and form *Cr[eophilus] maxillosus* of Europe, and the *C. villosus* of North America."

These islands were visited again in 1852 by members of the Swedish frigate 'Eugenie' and from the Coleoptera obtained during their stay, Boheman (1858–1859) described six new species; but, if any of the species collected by Darwin were among this material, records of them were not included in the account. The visit of H.M.S. 'Petrel,' in 1875, brought forth additional records of the Coleopterous fauna of these islands. The beetles collected on this

[1] Cont. Department, Trop. Research No. 186.

[2] *Necrobia rufipes.*

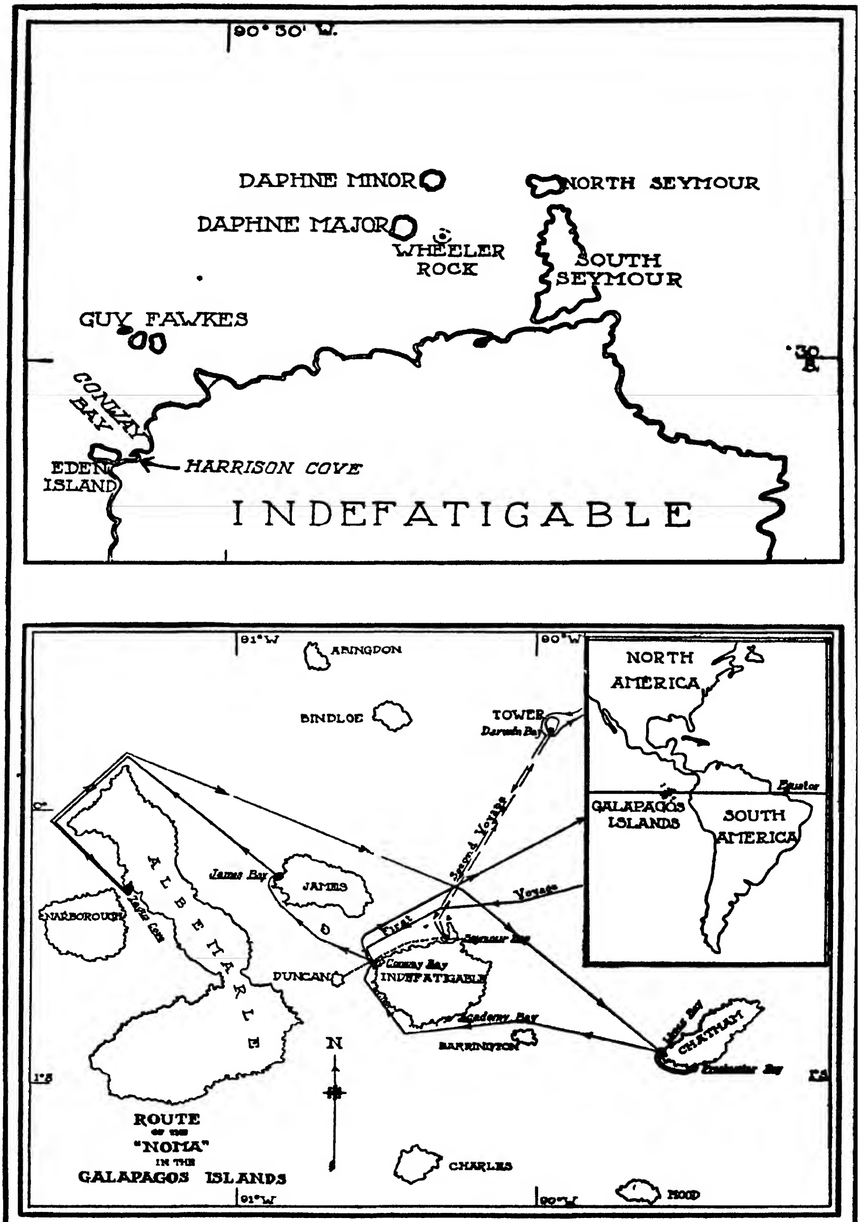

Plate A. SKETCH MAP OF GALAPAGOS ISLANDS
Route of the *Noma*, and details and location of the Archipelago.

expedition were treated by Mr. Charles Waterhouse (1877)[3] who described three new genera and six new species. He also lists the species known to him to have occurred in these islands and cites, when known, the particular islands on which they were collected. The list contains thirty-nine described species and one questionable form of *Philhydrus*. The next records were by Dr. L. O. Howard (1890) who, in an "Annotated Catalogue of the Insects Collected in 1887–1888, by naturalists of the U. S. Fish Commission, Steamer 'Albatross,'" lists nine species with the specific names. One of these, *Calosoma galapagoum* Hope, was found to be incorrectly determined as the form described by Hope, and was later treated as a new species by Linell. Dr. Howard also included a questionable species of *Mallodon* and mentions three unidentified specimens of Curculionidae. The species listed by Dr. Howard were determined by Martin Linell. The undescribed species contained in the above material were treated by Linell (1898) who also included the results of another 'Albatross' Expedition in 1891 and the collection made by Dr. G. Baur of Clark University during the same year. In the paper by Linell, which was printed posthumously, there are fourteen species described as new and six previously described species not included in former papers. There are also references with notes to species which had been recorded from the islands by Hope, Geo. R. Waterhouse, Boheman, and Howard.

There is also a record by F. X. Williams (1907) of the Expedition of the California Academy of Science, in which a list of the families of beetles, collected by that expedition, are given. The account is as follows: "Coleoptera, 150 species; one nocturnal species of *Cicindela; Calosoma* plentiful; Dytiscidae, 5 species; Gyrinidae, 1 species; Hydrophilidae, 1 species; few Staphylinids were found on rotting cactus and carrion; Coccinellidae, 3 species; Dermestidae were common; Histeridae not common; Elateridae, 5 species; Buprestidae, one small species; Cleridae, 1 species; several Ptinids; Scarabaeidae, 2 species—one a *Trox;* Cerambycidae, 10 species; Chrysomelidae, 2 small species; Tenebrionidae were common. Rhyncophora numerous." He also states that Coleoptera were abundant in cereals, especially on the vessel. The specimen of *Cicindela* mentioned in the above article was listed by Dr. Walther Horn in 'Genera Insectorum' (1915), fasc. 82^{c}, as *Cicindela galapagoensis* who gives as the authorities "Van Dyke, in litt.; Williams in litt." I believe the

[3] This paper was not included in the records by Martin Linell.

brief description of the species on pp. 238, 241, 251, 397 and 399, given by Dr. Horn in the above publication, are sufficient to establish the species and credit should be given him as the author. There is also a more complete description of the species in Archiv för Zoologi, 1920, XIII, No. 11, p. 17.

I have inquired of Dr. E. C. Van Dyke concerning the material collected by the California Academy of Sciences and have been informed that the above species is the only beetle, of the lot collected by F. X. Williams on the Galapagos Islands, which has been described.

The material before me was collected by the Harrison Williams Galapagos Expedition of the New York Zoological Society under the directorship of William Beebe. It includes twelve forms previously recorded from the islands, one species which is more or less cosmopolitan but not heretofore recorded and eight forms which I am herewith describing as new. It seems remarkable that six of the new species are contained in genera which have not heretofore been recorded from these islands, one of which, apparently, cannot be placed in any previously described genus.

I have also included in the following pages the description of a species of *Calosoma* which was collected by Dr. G. Baur and wrongly determined by Linell.

I wish to thank Mr. William Beebe for his kindness in allowing me the privilege of identifying this material, also to express my gratification to Prof. William Morton Wheeler for notes on the environment of many of the species.

The determination of the species has been greatly facilitated through the courtesy of the U. S. National Museum in allowing me the privilege of comparing specimens with the Linell material and the kindness of Mr. K. G. Blair in comparing specimens with the Waterhouse types in the British Museum.

Calosoma linelli sp. nov.

Calosoma galapageium (Hope) Linell, 1898, *Proc. U. S. Nat. Mus.*, XXI. p. 250.

This species was determined as *C. galapageium* Hope by Linell. The one specimen on which this determination was made was later sent to Mr. K. G. Blair of the British Museum, who returned it with the following remarks: "It . . . seems possible that Linell was mistaken as regards *galapageium* as the type is 16 mm. in length, is more shining than the other and does not in the least suggest a *Cychrus*."

The specimen was so fully described by Linell that I believe it better to repeat his diagnosis than to attempt to make a new description:

"Form and size of *Cychrus stenostomus*, apterous, smooth, and very shining. Head black, impunctate, mandibles piceous; labrum and palpi ferruginous. Antennae ferruginous, slightly darker outward, finely rufo-pubescent from the fifth joint, reaching the elytra to one-fourth the length from the base. Thorax black, aeneous at the base, entirely impunctate, slightly wider than long, subcordate, somewhat wider at apex than at base; disk feebly convex, not depressed at the sides; median line distinctly impressed; basal fovae rounded, deep, approximate to the sides; base truncate; posterior angles prolonged and deflexed. Elytra at base slightly wider than the thorax at middle, ovate, one-half longer than broad, dark cupreous green; humeri rounded; disk slightly convex, feebly (at sides and apex obsoletely) punctato-striate; intervals nearly flat, smooth; the third, seventh, and eleventh with feebly convex, elongate elevations, separated by rounded very shallow foveae, each fovea with a couple of punctures. Epipleura and ventral surface reddish brown, smooth. Legs ferruginous; tibiae sparsely and finely spinose, the intermediate ones strongly arcuate (male), expanded at apex, pubescent beneath and prolonged into a spine as long as the spurs; anterior tarsi (male) with the first three joints strongly dilated and densely spongy beneath, the first joint campanulate, the second widest, quadrate, the third strongly transverse, the fourth short, emarginate, two-thirds as broad as the third, with a few small spines and a trace of sponginess beneath, fifth joint narrow, cylindrical. Posterior coxae oval obtuse. Length, 12.5 mm.; width, 5 mm."

The above description was made from one male specimen, collected by Dr. G. Baur on Chatham Island, which I have made the type of the new species *linelli*.

The type and only representative, as far as known, of this new form, is in the collection of the U. S. National Museum.

Calosoma howardi Linell.

One specimen, James Island, April 5, and one, South Seymour, April 23. Running about singly on soil. Both of these specimens are probably females.

This species was described by Linell from ninety-two specimens: two from Duncan Island, twelve from Chatham Island, and seventy-eight from Charles Island. Collected by the Albatross Expedition in 1888 and 1891 and by Dr. G. Baur during 1891. The type of the species is in the U. S. National Museum.

Tachys beebei sp. nov.

(Fig. 42)

Brownish black, antennae slightly longer than the head and thorax, three basal joints testaceous, darker at the extreme apex, fourth joint darker at the apical half, fifth to eleventh dark throughout. Palpi testaceous. Mandibles testaceous, margined with darker. Head narrower than the thorax, black, closely and somewhat finely punctate, labrum darker and more coarsely punctate than other parts of head; frontal grooves extending back beyond the middle of the eye. Pronotum black, subquadrate, wider at apex than base, widest at about the apical third, sides distinctly margined, front angles acute, slightly produced, hind angles obtuse; very finely and obsoletely punctate, basal impression moderately deep and outlined by a single row of punctures which begin at the basal margin about half-way between the angles and the middle and curve slightly towards the center, median impression indistinct, slightly

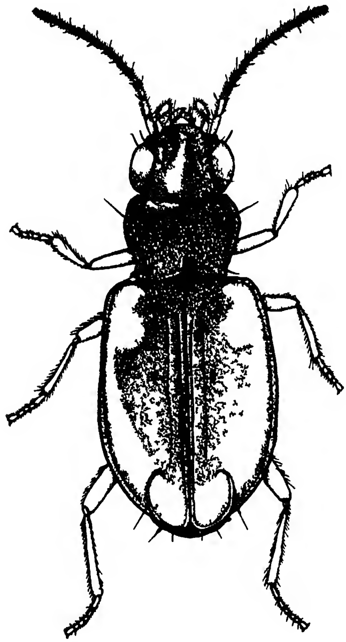

Fig 42.—*TACHYS BEEBEI* sp. nov

more distinct basally. Scutellum black. Elytra wider than the thorax, sub-lateral margins broadly pale, sutural portion black, the black covering about one-half the width of the elytra at the base, then becoming abruptly narrower, covering about one-third the width for the same distance longitudinally, from this point the black color gradually curves outwardly, the widest portion being slightly behind the middle where it again gradually curves inwardly to the suture at about the apical fifth, lateral margin dark to about the apical fifth; finely striate, the two inner striae more or less distinct, first dorsal puncture at the middle, second about one-fifth from the apex. Under surface black. Mouth-parts testaceous. Legs pale testaceous, coxae slightly darker Length 2.25 mm.

Described from eight examples from South Seymour, April, 1923. Collected under stones in damp mud around pools.

Type No. 28055 and seven *paratypes* No. 28056. Coll. Amer. Mus. Nat. Hist.

Eretes sticticus (Linnaeus).

One specimen collected on Chatham Island, April 7. In small pools among lava blocks.

This species was first listed, under the name *Eunectes occidentalis* Erichson, as occurring in the Galapagos Islands by Charles Waterhouse (1877, p. 77).

The record is as follows: "six examples, which agree very well with the brief description of this species, Hab. Charles Island, Cookson." The species was later listed by Sharp (1882, p. 697) as *Dytiscus sticticus* Linnaeus. It may be well to repeat the following remarks by Dr. Sharp: "Widely distributed in the warmer parts of the Old World, apparently rare in America. It is worthy of note that this species is found in a greater number of islands than any other of the Dytiscidae." Linell, in his paper, did not refer to the species.

Thermonectes basilaris (Harris).

One male and one female specimen. South Seymour, April. In small pools among lava blocks.

These specimens seem to be the same form as that listed by Charles Waterhouse (1877, p. 77) from Charles Island as *Acilius incisus* Aubé var. (a synonym of *Thermonectes basilaris* Harris). The following differences noted by Waterhouse apply also to the specimens which I have before me: "The male agrees perfectly with that of *A. incisus* [*T. basilaris*]. The female differs in having the thorax more punctured, and in having the elongate punctures on the elytra much stronger and more close than in any examples of *incisus* [*basilaris*], and the punctures although diminishing in strength and density, extend nearly to the apex."

I was at first inclined to consider the specimens as representing a new form but, after reading Waterhouse's remarks, I have come to the conclusion that it may be more advisable to consider them as belonging to the above species, as only the female varies from the typical form. I have compared the specimens with examples of *basilaris* in the American Museum collection and find that, although there is considerable variation in the density and depth of the punctures on the thorax and elytra of the females, none are as strongly punctured as in the specimens from the Galapagos.

Tropisternus lateralis Fabricius.

Three specimens, South Seymour, April 23. In small pools among lava blocks.

This species has been recorded from North and South America, including the Antilles, and is abundant in the United States from New York southwards. It is also abundant in Mexico and Central America. Geo. R. Waterhouse recorded the species as collected by Darwin but did not state on what island it was found. Charles Waterhouse records it as collected on Charles Island by Darwin and Cookson and says that it appears to be common in the Galapagos.

Bledius aequatorialis sp. nov.

(Fig. 43)

Male.—Elongate, testaceous. Antennae with basal joint elongate, second and third joints subequal in length, fourth joint shorter, fifth to tenth short, as wide or slightly wider than long, joint eleven longer, basal joints paler than the apical. Mandibles large, with a large tooth on the inner margin slightly before the middle. Head brownish black, front including labrum closely punctate, base more sparsely punctate, basal protuberances of antennae large and extending forward beyond the front margins of the eyes. Pronotum longer than wide, yellowish brown, slightly darker apically, somewhat coarsely

punctate; middle of apex prolongated in a sharp, slightly downwardly curved horn, which reaches over the head slightly beyond the clypeal margin; apical angles narrowly rounded, basal angles very broadly rounded, disk with a narrow median fovae extending from base to apex. Elytra short, a little longer than the

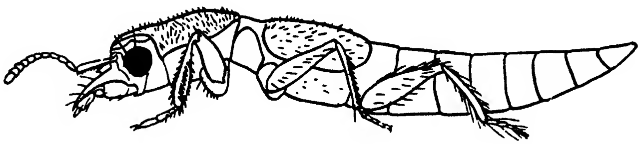

Fig. 43.—*BLEDIUS AEQUATORTALIS* sp. nov.

thorax, yellowish, covered with a very short, fine pubescence. Exposed dorsal segments with somewhat long hairs on the lateral regions and a few scattered hairs on the disk. Under surface and legs pale yellow. Length 4 mm.

Female.—Slightly darker than the male. Antennae not paler basally. Pronotum with apex squarely truncate. Otherwise as in the male. Length 4.5 mm.

Described from two specimens collected under stones in moist mud around pools on South Seymour, April, 1923. Holotype male No. 28057 and allotype female No. 28058. Coll. Amer. Mus. Nat. Hist.

Alloxacis seymourensis sp. nov.

Elongate, chestnut-brown, sparsely covered with a pale pubescence. Right mandible bifid at the tip; apical part especially on the outer margins black, base testaceous. Palpi testaceous, apical joint of the maxillary dilated, triangular. Antennae inserted close to the eyes, testaceous, about one-half the length of the body; first joint clavate, slightly curved outwardly, second joint short, less than one-half the length of the first, third and following joints subequal in length, eleventh joint constricted at the apical half. Head finely and sparsely punctate, basal margin more or less faintly rugose, eyes narrowly emarginate at the front, moderately coarsely granulate; labrum transversely impressed just behind the apical margin. Pronotum widest about the middle, curved at the apical part, more or less oblique behind, being narrowest at the basal margin, basal margins prominent; surface moderately sparsely punctate, pubescence more dense at the sides. Elytra subparallel, indistinctly costate, punctures fine and not very closely placed, pubescence short and fine. Under surface generally slightly darker than the upper, finely and not thickly punctate, pubescence short and fine. Legs paler than the under surface, tibiae on all of the legs with two spurs at the apex, tarsi with fourth joint dilated and spongy beneath, claws with a small tooth at the base. Length 6 mm.

Described from two specimens collected at South Seymour, April 23, on flowers of *Cordia lutea*.

Type No. 28059 and *paratype* No. 28060. Coll. Amer. Mus. Nat. Hist.

This species bears a superficial resemblance to the North American species of *Oxacis*, but on examination I find that the right mandible is bifid. It also has a well-defined, sharp tooth at the base of the claws similar to species of

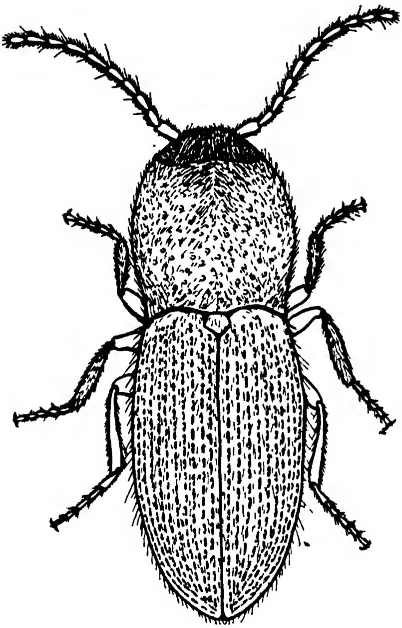

Fig. 44.—*COPTOSTETHUS WILLIAMSI* sp. nov.

the genus *Asclera*, but I have followed Dr. Geo. R. Horn and considered that the species belongs in the genus *Alloxacis* from the fact that the right mandible is bifid and the left entire, which is the only character used in separating the genera *Oxacis* and *Alloxacis*.

Coptostethus williamsi sp. nov.

(Fig. 44)

Female.—Wingless, dark brown, pubescent, with an intermixture of longer erect hairs. Antennae about as long as the head and thorax, serrate from the third joint onward, apex of last joint rounded, first joint thickened and about one-half longer than the second, third joint longer than the second, fourth and following joints shorter than the third and subequal in length. Head moderately finely punctate, inserted in the thorax to beyond the base of the eye. Thorax somewhat sparsely, coarsely punctate, sericeous pilose with large porrectly directed hairs, apical margin produced at the lateral angles, basal margin slightly bisinuate with lateral angles ending in a somewhat acute point, basal incisure strong. Scutellum cordiform. Elytra punctate-striate, each elytron with nine striae, interstices flat, slightly rugose, punctures large, elongate, deep; apical angles conjointly rounded. Underside of thorax coarsely and sparsely punctate. Abdominal segments more finely and more closely punctate. Legs slightly paler than the under surface. Tarsi with joints one to three of

approximately the same length, joints four and five each about two-thirds as long as joint three. Length 3 mm. Width 1.2 mm.

Described from one specimen from South Seymour, collected April, 1923.

Holotype No. 28061. Coll. Amer. Mus. Nat. Hist.

Necrobia rufipes (De Geer).

One specimen, Tower Island, April 23.

This species is cosmopolitan. It was recorded by Geo. R. Waterhouse, under the generic name *Corynetes*, as collected by Darwin on James Island.

Dermestes carnivorus Fabricius.

Two specimens, South Seymour, April 23.

This species is generally distributed over North and Central America. Linell records one example collected on Chatham Island by the Albatross Expedition in 1891.

Stomion laevigatum Geo. R. Waterhouse.

Twenty-five specimens collected on Daphne Major, April 22, and sixty-nine collected on Tower Island during April. This species was very abundant under stones in bottom of crater and were associated with *Ammophorus obscurus*. Representatives of this lot were sent to Mr. K. G. Blair, of the British Museum, for comparison with the Waterhouse types. The following reply concerning the species was received from Mr. Blair: "Your *Stomion laevigatum* do not quite agree with the type, in which the thorax is more constricted towards the base, and more convex towards the base, i.e. viewed sideways the thorax and elytra make more of an angle; the whole insect is decidedly narrower. The sculpture, however, seems to be identical and it seems that such differences as these are only sexual, at any rate yours seem to be both ♀ and mine both ♂."

After receiving the above reply I examined the specimens which I had determined as this species and find that some of them have the thorax slightly less constricted toward the base or, if viewed sideways, the thorax and elytra make less of an angle. I also find that some specimens are broader than others, but in the whole series I cannot find any difference in sculpture on which to separate them into different forms and therefore believe that they all belong to the above species.

Waterhouse, in the original description, did not mention on which island the species was collected.

Stomion galapagoensis Geo. R. Waterhouse.

There is one specimen collected on South Seymour in soil about roots of the large cactus, April 23, which agrees with the description of the above species in so far as it covers the parts described. The original diagnosis did not make any mention of the legs, which seem to be so different from other species examined that I think it well to give the following short description of them: legs coarsely punctured and with bristles arising from the punctures. The bristles on the femora moderately coarse, those on the tibiae and tarsi intermixed with coarser, and the tarsal ones being relatively coarser than those on the femora or tibiae. Front tibiae with a somewhat decided inward curve on the inner side; middle and hind tibiae straight.

This species was originally described by Waterhouse from two specimens collected by Darwin, but no mention was made to the island on which they were obtained.

Linell records seven examples on Chatham Island, six by the Albatross Expedition, 1888, and one by Dr. G. Baur. I have compared the one specimen collected by the Williams Expedition with those determined by Linell, but our specimen does not agree with them in all respects. Further study and comparison with the type material may show that either the Linell or our material represents a new form.

Ammophorus obscurus Geo. R. Waterhouse.

One hundred and seventy-eight specimens of this species were collected on Daphne Major during the month of April, under stones at the bottom of crater, associated with *Stomion laevigatum.*

I was somewhat doubtful of my determination of this species, from the description, and therefore compared examples with the specimen recorded by Linell as collected on southern Albemarle Island and found that it was an entirely different form. This led me to send a representative of our lot to Mr. K. G. Blair, of the British Museum, with the request that he compare them with the Waterhouse types. The following reply was received from Mr. Blair: "*Ammophorus obscurus* is correctly determined. If you can let me see one of the Linell specimens I shall be glad to compare it with the type of other species." The Linell specimen was later submitted to Mr. Blair who determined it as *A. bifoveatus* Geo. R. Waterhouse.

Pedonoeces pubescens Geo. R. Waterhouse.

One specimen collected on Tower Island, April 28.

This specimen agrees with the description of the type from Chatham Island, in most of the essential points, but the color is more pitchy brown than piceous black and the antennae and legs are ferruginous instead of piceous black.

Trox suberosus Fabricius.

One specimen, Conway Bay, Indefatigable Island, April 1.

Neither this genus nor species has heretofore been listed from these islands. The species has been recorded from North, Central, and South America, also from the West Indies and the Cape Verde Islands.

Trox seymourensis sp. nov.

Oblong-ovate, brownish black. Clypeus subangulate at the middle. Pronotum with surface roughly outlined, about one-third broader than long, sides curved and with an indentation near the basal angles, apex narrower than the base, apical margin produced at the sides, disk with an impression at each side which begins at the apical margin and extends obliquely from the apical angle to near the basal margin; central portion impressed. Scutellum longer than wide, sides subparallel, apex rounded. Elytra each with four rows of elongate tubercles slightly separated, thus forming interrupted carinae, intervals with three more or less interrupted rows of rounded tubercles, setae very short

and sparse, being visible only under a high-power lens. Front femora broad basally, inner portion somewhat coarsely punctate and with a somewhat dense mat of brown hairs on the basal two-thirds, outer portion coarsely granulate-punctate, lateral margins fringed with stiff, bristle-like hairs, those on the outer margin arising from somewhat deep-set punctures. Front tibiae with a somewhat large median tooth and with two smaller tooth-like projections on the basal half, the projection nearest the median tooth being the larger. Middle and hind legs more or less coarsely punctured and with a row of bristles on the margins. Length 10.5 mm.

Described from one specimen collected on South Seymour, April 23.

Type No. 28062. Coll. Amer. Mus. Nat. Hist.

There is also in the collection one elytron taken on Tower Island, April 28, which is no doubt a fragment from a specimen of the same species.

Stenodontes moliarius (Bates).

One specimen.

This species was listed by Howard as *Mallodon* sp.? The same specimens were identified by Linell as *Mallodon* (*Stenodontes*) *moliarium*, whose records are as follows: "The *Albatross* expedition in 1888 collected on Charles, Chatham, and Duncan islands seventeen examples of this large Prionid, which is distributed through Mexico and Central America to Panama."

Docema darwini sp. nov.

Oblong, subparallel. Upper surface black, glabrous, shining. Antennae yellow with apical joints slightly darker; sparsely covered with a pale yellow pubescence which becomes more dense on the apical joints. Palpi dark. Eyes somewhat coarsely faceted. Head not noticeably punctate. A median carina extends from the frontal margin of the head to slightly beyond the bases of the antennae. At the back of the head is a V-shaped excavation, the apical portion of which connects with the basal end of the carina, thus forming a Y-shaped outline with the carina as the stem of the Y. Pronotum broader than long, slightly narrowed apically, finely but not very closely punctate, lateral margins somewhat broad, antebasal impression deep and extending to near the lateral margins. Scutellum transverse. Apex broadly rounded. Elytra moderately coarsely punctate on the basal half becoming finer apically, the punctures arranged in more or less distinct rows; humeral angles somewhat prominent with a raised line extending from the umbone to the apical third; lateral margins well developed, epipleurae broad at the base, gradually narrowing and becoming obsolete at the apex. Under surface black, sparsely covered with pale pubescence. Legs brown, sparsely covered with pale pubescence; femora generally dark brown, almost black in some specimens, tibiae and tarsi paler than femora, apical tarsal joints darker in some examples. Length 2.2–2.5 mm. Described from fifteen specimens collected on Tower Island during April and one specimen from Eden, April 4. All taken on low bushes along the beach.

Type No. 28063 and *paratypes* 28064. Coll. Amer. Mus. Nat. Hist.

Pantomorus galapagoensis Linell.

One male and two females, Conway Bay, Indefatigable Island, April 1.

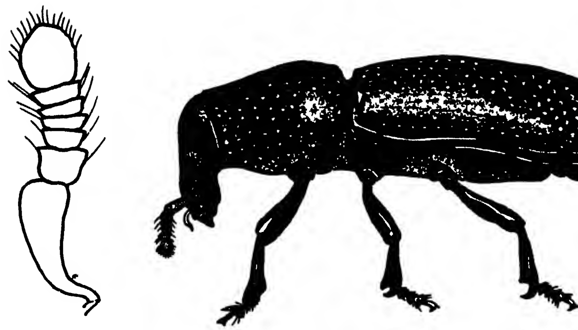

Fig 45 —*NEOPENTARTHRUM TOWERENSIS* sp nov

Described by Linell from one male and three females, collected on Chatham Island. The type of this species is in the U. S. National Museum.

Neopentarthrum gen. nov.

Rostrum moderately long and somewhat broad, slightly arched, apical part at sides in front of antennae parallel; basal part slightly constricted; scrobes oblique, extending backwards to the under margins of the eyes. Antennae short, inserted in front of the middle, scape moderately short, club-shaped; funicle five-jointed, first joint thick, about as long as the second and third taken together, joints two, three, and four gradually shorter and not as thick as the first joint, the five joints with bristle-bearing punctures; club moderately large and as long as joints two, three, and four combined, pubescent, apex with two or more annulations. Eyes moderately large, situated at the base of the rostrum, convex, facets moderately coarse. Prothorax narrowed and constricted in front, more gradually narrowed behind. Scutellum small, distinct, rounded at apex. Elytra oblong, wider at base than the thorax, subparallel to apical third where they become slightly but gradually narrower, apices rounded. Legs short and stout, femora inflated, tibiae slightly triangular with prominent hooks at the apex. Tarsi with first joint somewhat elongate, second joint short, third joint deeply emarginate and a little longer than the second, claw joint about as long as the second and third combined. Body beneath slightly convex, glabrous.

I have erected this genus to include a new species, *towerensis*, of Cossoninae found in the Galapagos Islands by the Williams Expedition. There is, seemingly, no genus in the pentarthrid group which agrees with the generic characters found in this species.

Neopentarthrum towerensis sp. nov.

(Fig. 45)

Subcylindrical, piceous, shining. Antennae short and thick, scape short, clavate, funicle five jointed, first joint large; other joints closely united and gradually smaller, club slightly paler than the other part, appearing annulate under a high power. Beak moderately densely and somewhat finely punctate.

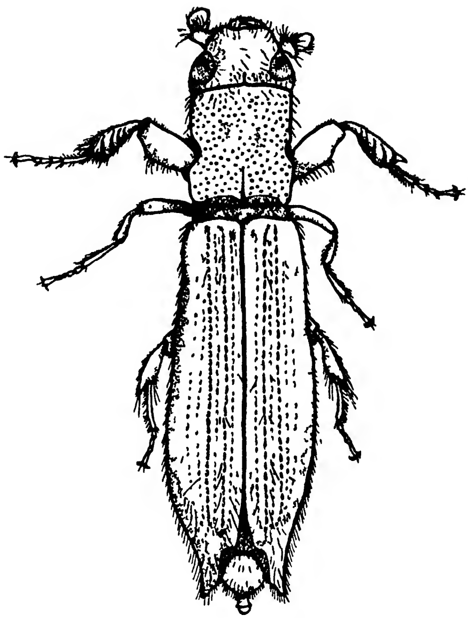

Fig. 46.—*PLATYPUS SANTACRUZENSIS* sp. nov.

Eyes situated at base of beak, small, slightly convex. Pronotum slightly longer than wide, apex constricted behind the apical margin; from this constriction the sides gradually curve outwardly to about the middle where they again gradually curve inwardly to the base; disk moderately coarsely punctate, those on the central portion being the coarser. Scutellum small, rounded at apex. Elytra slightly wider than the base of the thorax, cylindrical, surface feebly striate, striae with coarse punctures, intervals flat, each with a row of small punctures. Body beneath somewhat coarsely and sparsely punctured. Legs short, femora swollen apically; tibiae broadening apically ,apex with the usual claws; tarsi with the basal joint longer than the second, second and third about equal in length, claw joint nearly as long as the other three taken together. Front coxae narrowly separated. Length 2–2.75 mm.

Described from seven specimens taken on Tower Island, April 28. Burrowing in numbers under bark of bushes.

Type No. 28065 and *paratypes* No. 28066. Coll. Amer. Mus. Nat. Hist.

Platypus santacruzensis sp. nov.

(Fig. 46)

Male.—Elongate, cylindrical, flavous. Mandibles with apex and outer margin darker. Head slightly wider than the thorax, sparsely covered with paler hairs; front flat, sloping forward, moderately coarsely and closely granulate-punctate; basal portion smooth, median black line extending from the basal

margin to the sloping portion. Pronotum longer than wide, very finely but not closely punctate, and with a few scattered hairs along the apical and front part of the lateral margins; disk with a short basal median line. Scutellum strongly depressed and acuminate. Elytra somewhat deeply striate-punctate and with a few scattered hairs which become more closely placed at the lateral margins and at the apex; apical part dark, narrowed, sutural angle squarely truncate, lateral angle prolonged, apex tridentate. Under surface, except abdominal segments, finely and somewhat sparsely punctate, abdominal segments more closely and coarsely punctate, sparsely covered with somewhat stiff hairs. Front tarsal joint prolonged as usual in Platypodidae. Length 4.75 mm.

Described from one specimen which was collected while it was flying along the shore of Seymour Bay, Indefatigable Island.

Holotype No. 28067. Coll. Amer. Mus. Nat. Hist.

LIST OF COLEOPTERA KNOWN TO OCCUR IN THE GALAPAGOS ISLANDS

The following list contains, as far as I have been able to ascertain, all of the species of Coleoptera[4] which have been reported as being found in the Galapagos Islands. There are seventy-three species included therein, or more than twice as many as Wallace[5] recorded in his reference to the insects and land shells found in this archipelago. His remarks on the paucity of the insect fauna are as follows: "The insects are very scanty; the most plentiful group, the beetles, only furnishing thirty-five species, belonging to twenty-nine genera and eighteen families. The species are almost all peculiar, as are some genera. They are mostly small and obscure insects, allied either to American or world wide groups. The Carabidae and Heteromera are the most abundant group, the former furnishing six and the latter eight species."[6] The numerical proportions of groups are not very different in the present list but the Carabidae are fewer as, in the addition of forty forms this family has furnished only five species, or slightly more than twelve per cent. The Tenebrionidae (Heteromera of Wallace) has furnished eight additional forms, or twenty per cent of the total addition. The species which have been added to the list give us an addition of only three families (Wallace lists only eighteen families but he included, as the families are now known, three in the Malacodermes and three in the Necrophaga) but they have raised the number of genera to fifty-five, or an addition of twenty-two (some of the species listed by Wallace as belonging in one genus were found to belong in two or more genera).

There has been much discussion as to the introduction of animals on these islands, whether by land bridges or on floating masses.

[4] I have not considered the California Academy of Sciences material as this material has not been definitely determined.

[5] 'Island Life,' 1880. In this paper Wallace lists thirty-seven species, taken from the records of Waterhouse, 1877, Proc. Zoöl. Soc. London.

[6] Wallace did not include *Calosoma galapageium* Hope in his list of Carabidae. He also omitted *Stomion galapagoensis* Geo. R. Waterhouse, *Ammophorus galapagoensis* Geo. R. Waterhouse, *Pedonoeces costatus* Geo. R. Waterhouse and *Pedonoeces morio* Geo. R. Waterhouse in his list of Heteromera.

It is noteworthy (1) that even the present enlarged list includes but a small part of the fauna to be expected if there had been a land bridge and (2) that the habits of the species now on the islands are such as would be expected of insects that had been introduced either by floating masses or by man. In this connection the following theory expounded by Wallace may prove interesting: "The observation of Captain Collnet, quoted by Mr. Darwin in his *Journal*, that drift-wood, bamboos, canes, and the nuts of a palm, are often washed on the southeastern shores of the islands, furnishes an excellent clue to the manner in which many of the insects and land-shells may have reached the Galapagos. Whirlwinds also have been known to carry quantities of leaves and other vegetable *debris* to great heights in the air, and these might be then carried away by strong upper currents and dropped at great distances, and with them small insects, and mollusca, or their eggs." The probable introductions, if any, through the agency of man are the scavenger and wood-boring forms. The reason forincluding the latter here is that six conspicuous species of Cerambycidae appear to be of recent introduction, as they were not reported by the earlier writers and these beetles would almost certainly have been found, had they been there. They were probably taken over in wood which formed a part of boat's cargo or of the boats themselves.

The references to literature merely refer to the original description of the species and such papers which treat on their distribution in the Galapagos Islands. Species marked by the *asterisk* are those which are not indigenous to the Galapagos Islands.

Family CICINDELIDAE

Cicindela galapagoensis W. Horn, 1915, pp. 238, 241, 251, 397, 399 and 402. 1920, p. 17. Listed as *Cicindela* sp.? by F. X. Williams, 1907, p. 260.

Family CARABIDAE

Calosoma galapageium Hope, 1837, p. 130.

Calosoma howardi Linell, 1898, p. 251. Listed by Howard, 1889, p. 191, as *Calosoma galapagoum?* Hope.

Calosoma linelli sp. nov. Listed as *Calosoma galapageium* Hope, by Linell, 1898, p. 250.

Scarites galapagoensis Linell, 1898, p. 253.

Tachys beebei sp. nov.

Pterostichus calathoides (Geo. R. Waterhouse), 1845, p. 21. Described under the generic name of *Feronia*. Listed by Charles Waterhouse, 1877, p. 82, as *Feronia*. Howard, 1889, p. 191, listed under the generic name *Poecilus*. Linell, 1898, p. 252, listed under the generic name *Pterostichus*.

Feronia insulars Boheman, 1858, p. 14. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 255.

Notaphus galapagoensis (Geo. R. Waterhouse), 1845, p. 23. Charles Waterhouse, 1877, p. 81. Linell, 1898, p. 255.

Amblygnathus obscuricornis Geo. R. Waterhouse, 1845, p. 22. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 255.

Platynus galapagoensis (Geo. R. Waterhouse), 1845, p. 21. Described under

the generic name of *Feronia*. Listed by Charles Waterhouse, 1877, p. 82, as *Feronia*. Linell, 1898, p. 252, lists it under the generic name of *Platynus*.

Selenophorus galapagoensis Geo. R. Waterhouse, 1845, p. 22. Charles Waterhouse, 1877, pp. 77 and 82. Howard, 1889, p. 191. Linell, 1898, p. 254.

Family DYTISCIDAE

Copelatus galapagoensis Geo. R. Waterhouse, 1845, p. 23. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 255.

* *Thermonectes basilaris* (Harris), 1829, p. 8. Listed by Charles Waterhouse, 1877, pp. 77 and 82, as *Acilius incisus* Aubé var.

* *Eretes sticticus* (Linnaeus), 1766, p. 666. Listed by Charles Waterhouse, 1877, pp. 77 and 82, as *Eunectes occidentalis* Erichson. Sharp, 1882, p. 699, lists it as *Dytiscus sticticus*.

Family HYDROPHILIDAE

* *Tropisternus lateralis* (Fabricius), 1775, p. 228. Geo. R. Waterhouse, 1845, p. 26. Charles Waterhouse, 1877, pp. 78 and 82. Linell, 1898, p. 255.

Philhydrus species? Geo. R. Waterhouse, 1845, p. 26. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 255.

Family SILPHIDAE

Acribis serrativentris Charles Waterhouse, 1877, pp. 78 and 82.

Family STAPHYLINIDAE

Bledius aequatorialis sp. nov.

* *Creophilus villosus* (Gravenhorst), 1802, p. 160. Geo. R. Waterhouse, 1845, p. 24, as *Creophilus* sp. Charles Waterhouse in 1877, p. 82, records the species as *villosus*. Linell, 1898, p. 255, not knowing of the Waterhouse article, says: "This is probably *Creophilus villosus* Gravenhorst, introduced from North America."

Family MELYRIDAE

Ablechrus flavipes Charles Waterhouse, 1877, p. 79. [Listed by Charles Waterhouse, 1877, p. 81, as *Ablechrus darwinii*.]

Family CORYNETIDAE

* *Necrobia rufipes* (De Geer), 1775, p. 165. Geo. R. Waterhouse, 1845, p. 26 and Charles Waterhouse, 1877, p. 81, refer to the genus as *Corynetes*. Linell, 1898, p. 257.

Family OEDEMERIDAE

Oxacis galapagoensis Linell, 1898, p. 266.

Alloxacis seymourensis sp. nov.

Family ELATERIDAE

Anchastus galapagoensis Geo. R. Waterhouse, 1845, p. 25. Charles Waterhouse,

1877, p. 82. Linell, 1898, p. 256. [Described by Geo. R. Waterhouse and listed by Charles Waterhouse and Linell under the generic name *Physorhinus.*]

Heterocrepidius puberulus Boheman, 1858, p. 66. Linell, 1898, p. 256.

Coptostethus williamsi sp. nov.

Family DERMESTIDAE

* *Dermestes carnivorus* Fabricius, 1775, p. 55. Linell, 1898, p. 256.

* *Dermestes vulpinus* Fabricius, 1781, p. 64. Geo. R. Waterhouse, 1845, p. 26. Charles Waterhouse, 1877, p. 81. Linell, 1898, p. 256.

Family PHALACRIDAE

Phalacris darwinii Charles Waterhouse, 1877, pp. 78 and 82.

Family COCCINELLIDAE

Scymnus galapagoensis Geo. R. Waterhouse, 1845, p. 41. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 256.

Family ALLECULIDAE

Lobopoda galapagoensis Linell, 1898, p. 266. This species was listed by Howard, 1889, p. 192, with the following remark: "Two specimens of a species *Allecula* probably new from Charles Island."

Family TENEBRIONIDAE

Stomion galapagoensis Geo. R. Waterhouse, 1845, p. 29. Charles Waterhouse, 1877, pp. 79 and 82. Howard, 1889, p. 192. Linell, 1898, p. 262. [According to determinations made by Mr. K. G. Blair *Stomion piceum* Linell, 1898, p. 262, and *Stomion carinipenne* Linell, 1898, p. 262, also belong to this species.]

Stomion bauri Linell, 1898, p. 263.

Stomion helipioides Geo. R. Waterhouse, 1845, p. 30. Charles Waterhouse, 1877, p. 82. Howard, 1889, p. 192. Linell, 1898, p. 263.

Stomion laevigatum Geo. R. Waterhouse, 1845, p. 30. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 263.

Ammophorus galapagoensis Geo. R. Waterhouse, 1845, p. 30. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 263.

Ammophorus bifoveatus Geo. R. Waterhouse, 1845, p. 31. Charles Waterhouse, 1877, p. 81. Howard, 1889, p. 192. Linell, 1898, p. 263 [and in error as *A. obscurus* on p. 264].

Ammophorus cooksoni Charles Waterhouse, 1877, pp. 80 and 82.

Ammophorus caroli Linell, 1898, p. 264. [This species is without much doubt synonymous with *cooksoni.*]

Ammophorus obscurus Geo. R. Waterhouse, 1845, p. 32. Charles Waterhouse, 1877, p. 82. [The Linell record of this species, based on the determination made by Mr. K. G. Blair, has been credited to *A. bifoveatus.*]

Pedonoeces galapagoensis Geo. R. Waterhouse, 1845, p. 35. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 265.

Pedonoeces costatus Geo. R. Waterhouse, 1845, p. 35. Linell, 1898, p. 265.

Pedonoeces morio (Boheman), 1858, p. 92. [Described under the generic name of *Tessaromma.*] Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 265.

Pedonoeces pubescens Geo. R. Waterhouse, 1845, p. 36. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 265.

Pedonoeces bauri Linell, 1898, p. 265.

* *Gnathocerus cornutus* (Fabricius), 1798, p. 51. Linell, 1898, p. 266.

Phaleria manicata Boheman, 1858, p. 92. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 266.

Family BOSTRICHIDAE

* *Tetrapriocera longicornis* (Olivier), 1790, p. 15. Howard, 1889, p. 191, Lists this species with the following note: "One specimen of *Tetrapriocera* was collected on Indefatigable Island. Although the same habitus it is probably different from our Florida species, *T. longicornis* Oliv., which is known to have a wide distribution in Central and South America." Linell, 1898, p. 256.

* *Amphicerus cornutus* (Pallas), 1772, p. 18. Linell, 1898, p. 256, as *A. punctipennis.*

Amphicerus cornutus subspecies *galapaganus* Lesne, 1910, pp. 183–186. The first record of the representatives of this species was based on three specimens found by Charles Darwin on the dead branches of a Mimosa tree in Chatham Island. They were listed by Geo. R. Waterhouse, 1845, p. 36, as belonging in the genus *Apate* but no specific designation was given to them. This same series of specimens was later recorded by Charles Waterhouse, 1877, p. 82, as *Bostrichus unicantus* with a footnote, referring to the above, which reads as follows: "The *Apate* mentioned by Waterhouse, Ann. and Mag. Nat. Hist., 1845, XVI, p. 36." Linell, 1896, p. 256, not knowing of the determination by Charles Waterhouse, combined the records of Darwin's specimens with a specimen collected by Dr. G. Baur on Albemarle Island, which Linell determined as *Amphicerus punctipennis* = *cornutus.* The Darwin specimens were later studied by Lesne, who described them as *Schistoceros* = *Amphicerus cornutus* subspecies *galapaganus.* In his description of this new form Lesne says that he has not seen the specimen collected by Dr. G. Baur but has studied the four (2 male and 2 female) specimens [Waterhouse lists only three specimens] collected by Darwin. In his article Lesne makes no mention of Charles Waterhouse's determination of the species.

The specimen collected by Dr. G. Baur may also belong in this subspecies but, as it has not been determined as such, I have followed Linell and listed it as *cornutus.*

Family SCARABAEIDAE

Copris lugubris Boheman, 1858, p. 42. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 258.

Parapseudorycles galapagoensis (Geo. R. Waterhouse), 1845, p. 26. Charles Waterhouse, 1877, p. 82. Howard, 1889, p. 191. Linell, 1898, p. 258,

described the genus *Pseudorycles* for this species, the former authors having listed it under the genus *Oryctes.* I have herewith changed the generic name to *Parapseudoryctes* as the name *Pseudoryctes* is a homonym, it having been used by Sharp (1873, Rev. et Mag. Zool., (3) I, p. 267) for species found in Australia, which are not congeneric with the Galapagos forms.

* *Trox suberosus* Fabricius, 1775, p. 31. [The record which I have embodied in this paper is, to my knowledge, the first from these islands.]

Trox seymourensis sp. nov.

Family PASSALIDAE

* *Neleus tlascala* Percheron, 1835, p. 45. Linell, 1898, p. 257.

Family CERAMBYCIDAE

* *Stenodontes moliarius* (Bates), 1879, p. 9. Howard, 1889, p. 191, as *Mallodon* sp.? Linell, 1898, p. 259, under the generic name *Mallodon.*

Achryson galapagoensis Linell, 1898, p. 259.

Eburia lanigera Linell, 1898, p. 259.

Eburia bauri Linell, 1898, p. 260.

Eburia amabilis Boheman, 1859, p. 150. Charles Waterhouse, 1877, p. 82. Howard, 1889, p. 192. Linell, 1898, p. 261.

Acanthoderes galapagoensis Linell, 1898, p. 261.

Family CHRYSOMELIDAE

Docema galapagoensis Geo. R. Waterhouse, 1845, p. 39. Described as *Haltica galapagoensis.* Charles Waterhouse, 1877, pp. 81 and 82. [In this paper Charles Waterhouse erects the genus *Docema* for this species.] Linell, 1898, p. 262, not knowing of the Charles Waterhouse paper, lists the species under the genus *Haltica.*

Docema darwini sp. nov.

Longitarsus lunatus Charles Waterhouse, 1877, p. 81.

Diabrotica limbata Charles Waterhouse, 1877, pp. 81 and 82.

Family PLATYSTOMIDAE

Ormiscus variegatus Geo. R. Waterhouse, 1845, p. 37. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 268.

Family CURCULIONIDAE

Otiorhynchus cuneiformis Geo. R. Waterhouse, 1845, p. 38. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 267.

Pantomorus galapagoensis Linell, 1898, p. 268. [This species was listed but without a name by Howard 1889, p. 192, with the following remark: "Three specimens belonging to this family [Curculionidae] were collected on Chatham Island."]

Anchonus galapagoensis Geo. R. Waterhouse, 1845, p. 39. Charles Waterhouse, 1877, p. 82. Linell, 1898, p. 268.

Neopentarthrum towerensis sp. nov.

Family PLATYPODIDAE

Platypus santacruzensis sp. nov.

Family SCOLYTIDAE

Linell, 1898, p. 268, records a single specimen without elytra, belonging in the group Hylurgi.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

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HEMIPTERA-HETEROPTERA[1]

FROM THE WILLIAMS GALAPAGOS EXPEDITION

By H. G. Barber

(Figs. 47–50 incl.)

The Hemiptera-Heteropterous fauna from the Galapagos Islands so far as known is rather limited. I have been able to find only twenty-one species so far listed from the islands and two species of Halobates from neighboring waters. Twelve of these are restricted to the islands and ten are also neotropical species. From the collections made by William Beebe on this expedition of the New York Zoological Society, I have been able to add nine more species to the island fauna, seven of which are new, and one new species of *Halobates*. The drawings have been made by myself.

Family PENTATOMIDAE

Acrosternum (*Nezara*) *viridans* Stål.

> *Acrosternum* (*Nezara*) *viridans* Stål Stål, *Freg. Eugen. Resa-Insects*, 228, 1859; *Enum.*, II, 41, 1872. Howard, *Proc. U. S. Nat. Mus.*, XII, 194, 1889. Heidemann, *Proc. Washington Acad. Sci.*, III, 365, 1901.

Two from James Island, April 5, and two from Chattam Island, April 7. This has been recorded by Stal also from Panama and Peru.

Podisus (*Arma*) *sordidus* Stal.

> *Podisus* (*Arma*) *sordidus* Stål. Stål, *Freg. Eugen. Resa-Insects*, 221, 1859; *Enum.* I, 51, 1870.

Two from Indefatigable Island, April 22. Also known from Peru.

Family COREIDAE

Stenocephalus insularis Dallas.

> *Stenocephalus insularis* Dallas. Dallas, *List Hem.* II, 482, 1852. Stål, *Enum.* I, 218, 1870. Heidemann, *Proc. Washington Acad. Sci.*, III, 365, 1901.

Ten from James Island, April 4 and 5, and Albemarle Island, April 6.

Dallas described this species from material obtained by Charles Darwin on his voyage of the *Beagle*.

Harmostes disjunctus sp. nov.

(= *H. serratus* Heidemann nec Fabr.)

Color yellow-brown, with paler costal margin of corium and the femora spotted with brown; membrane obscurely spotted. Head finely granulate, as

[1] Cont. Department Trop. Research No. 187.

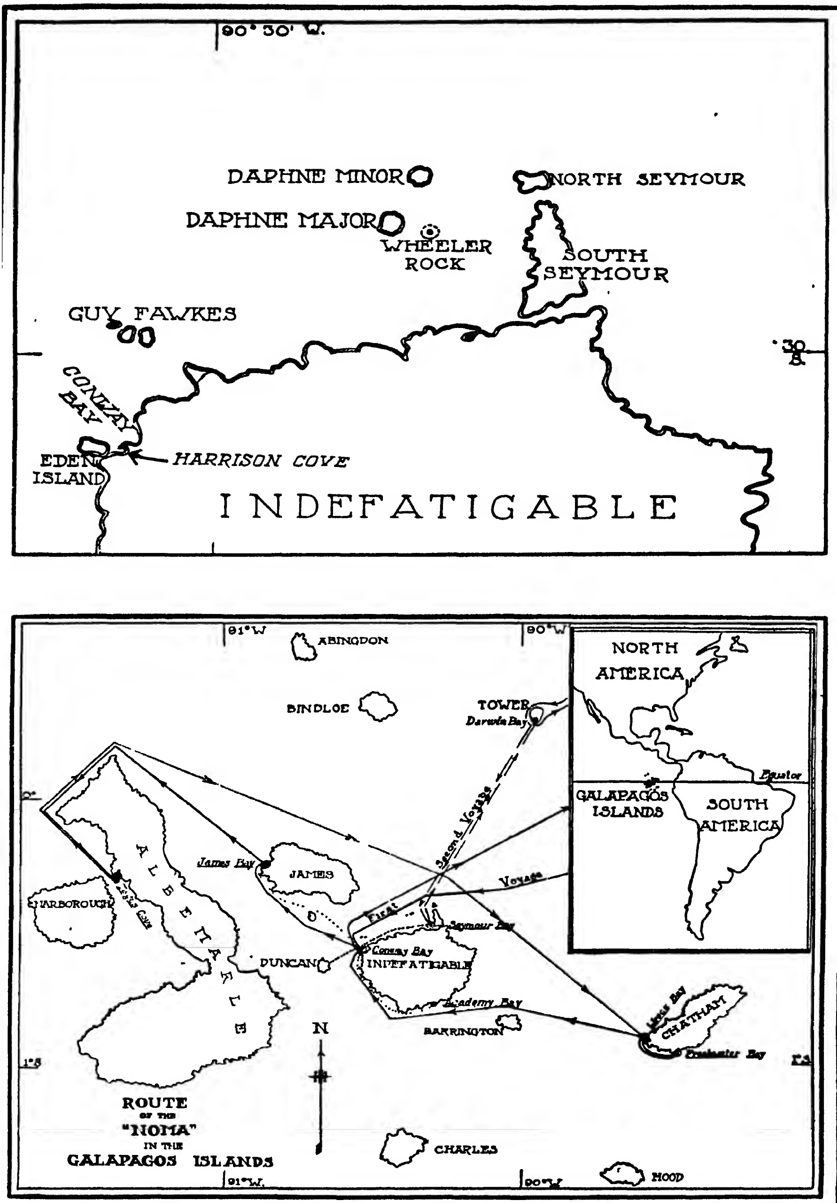

Plate A. **SKETCH MAP OF GALAPAGOS ISLANDS**

Route of the *Noma*, and details and location of the Archipelago.

long as wide; tylus elevated, acute, about attaining middle point of the first antennal segment; antenniferous tubercles acute, nearly porrect, slightly turned outwards towards apex, extended forward on a line with the apices of the jugae; vertex with a narrow median sulcus extending from line of the ocelli to near base of the tylus. Antennae 3.75 mm. long, with granulated basal segment stout, 1.5 mm. long; second and third segments much more slender, cylindrical, neither especially incrassate at their apices, second segment 1 mm., third 1.5 mm. long; piceous terminal segment spindle-shaped, one-half as long as third segment. Head paler beneath with a piceous streak behind the bucculae, the latter disappearing on a line with the front margin of the eyes. Rostrum extending only to the anterior part of the posterior coxae, the basal segment reaching to a line drawn across posterior margins of the eyes. Pronotum only a trifle shorter than head and just twice as wide across humeral angles as it is long; lateral margins slightly and evenly arcuate, the edge reflexed and provided with a few rather weak, pale teeth, the anterior ones forming an acute anteriorly directed process; surface, except for the cicatrices and along the narrow margin before these, closely, almost confluently, coarsely punctate; provided with a median longitudinal pale carina; humeral angles rounded or obtusely angled, not projecting much beyond costal margin of corium; humeri somewhat roundly elevated within and these connected by a somewhat evident transverse ridge, placed just before the posterior margin of the pronotum.

Scutellum more shallowly punctate; apical part narrow, evenly rounded, with the edge pale, elevated, the surface within scooped out. Corium and clavus concolorous or the former slightly variegated with pale brown; these parts evenly, coarsely, almost confluently punctate; the pale impunctate costal margin reflexed and provided with 11 to 12 almost equi-distant dark brown spots; the outline of the costal margin, viewed from above, scarcely at all concavely sinuate, the greatest width across the hemielytra being two-thirds the distance from the base; apex of the corium, at least in the male, reaches to the apex of the abdomen. Membrane hyaline, with scattered indistinct brownish spots. Beneath paler than above. Central disk of sternites with a piceous spot, widest on the mesosternum; meso- and meta-pleura closely, shallowly punctate with faint indications of darker maculations. Venter pale yellow-gray, with numerous rosy red spots and with a short transverse piceous fascia on the sides of the 4th, 5th and 6th segments, placed closer to the lateral margins than to the median line; anteriorly very obscurely sulcate in the middle. Legs pale ochraceous, the femora, except at base, much spotted with ferrugineous-brown, the posterior ones about twice the diameter of the others and armed beneath with three strong white spines with smaller, close set, dark spines between the distal two; apex reaches back only as far as the apex of the corium.

Length male 6 mm.

Type and *paratype* males: Indefatigable Island.

This species is very close to *H. affinis* described by Dallas from an unknown locality and fixed by Van Duzee in 1909 for the Florida species. I have Florida as well as numerous West Indian specimens for comparison. There is no doubt that this Galapagos species is what Heidemann, 1901, misidentified as *serratus* Fab. I have seen Heidemann's specimen in the collection of U.S.N.M.

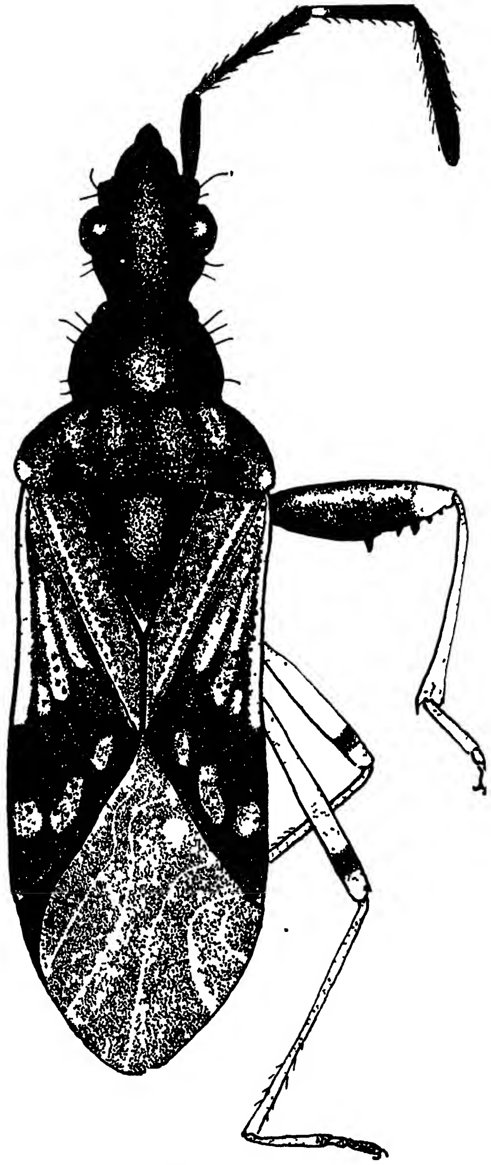

Fig 47. *HERAEUS PACIFICUS* sp. nov.

H. disjunctus differs from *serratus* especially by its more quadrate head, shorter rostrum, less pronounced spinous process of tylus and antenniferous tubercles. From *affinis* it may readily be separated by the following characters: the different relative lengths of the second and third antennal segments, straighter costal margins, corium reaching to apex of the abdomen, shorter posterior femora and almost non-sulcate venter. By its denticulate pronotal margin it differs from the following South American forms: *raphimerus* Spin., *minor* Spin., *marmoratus* BI., *apicatus* Stal and *prolixius* Stal.

Corizus hyalinus Fabricius.

Corizus hyalinus Fagricius Fabricius, *Ent. Syst.* 168, 1794.

Four from Daphne Major April 22, and three from Tower Island April 28. These are all dark specimens of this widely distributed species, not hitherto reported from these islands. *C. lugens* Stal is unknown to me.

Nysius (Cymus) marginalis Dallas.

Nysius (Cymus) marginalis Dallas Dallas, *List Hem.* II, 556, 1852. Stål, *Freg Eugen. Ins.*, 252, 1858; *Enum.* IV, 122, 1874. Butler, *Proc. Zool. Soc. London*, 88, 1877. Heidemann, *Proc. Washington Acad. Sci.*, III, 366, 1901.

Eight from Daphne Major, April 22. So far as known this is an endemic species.

Heraeus pacificus sp. nov.

(Fig. 47)

Color dull fusco-ferrugineous, with anterior lobe of pronotum, scutellum and sternum black; posterior lobe of pronotum with four streaks and humeral angles brown; corium with narrow costal margin to just beyond middle, a subapical spot, two others near posterior margin and the inner field fasciate with testaceous; membrane brown with pale veins. Head and anterior lobe of pronotum with a few long setae. Head equally long as pronotum and slightly narrower across eyes than width of posterior lobe of pronotum, transversely finely granulose with sparse covering of very fine appressed, grayish pubescence; apex of tylus reaching midway on basal antennal segment, anteocular distance to apex of antenniferous tubercles two-thirds the length of an eye, postocular region gradually contracted. Antenna with extreme base of second and third segments pale, slightly enlarged basal segment but slightly longer than the anteocular part of head, second segment about twice as long as first and one-third longer than third, fourth segment subequal to second; all segments except basal with fine short hairs. Rostrum reaching to middle of hind coxae, the enlarged basal segment dark castaneous, remainder, except at apex, pale; first segment reaching mid-way on postocular region of head, second segment one-third longer, third a little shorter than second. Pronotum as long as head, with the two lobes of nearly equal length, the anterior one dull black provided with a few erect hairs, posterior lobe sparsely, finely punctate, one-third wider than anterior lobe; rounded humeri and four longitudinal streaks paler. Scutellum dull black, disk somewhat paler either side of the middle, extreme apex testaceous. Hemielytra non-pilose; clavus finely, closely punctate with outward pale, smooth ruga reaching nearly to apex; corium sparsely punctate between the veins. Membrane dark brown with distinct pale veins. Sternum dark

with rim of all acetabuli and the posterior flange of the meta-pleura ferrugineous, enlarged fore femora shining dark castaneous with only the apex pale, armed beneath with several strong teeth beyond the middle; fore tibia slightly curved, pale stramineous, infuscated at apex; middle and hind femora pale stramineous with a pre-apical castaneous ring; tibiae pale, infuscated at tip; all tarsi pale, infuscated apically. Venter ferrugineous with coating of fine appressed pale hairs.

Length 6 mm.

Type.—Male, James Island, April 4; *allotype,*—James Island, April 4; two *paratypes*, male and female, James Island, April 4. This species is rather closely related to *H. plebejus* Stål, but is darker in color and less pilose, the antennae longer and the diameter of corium relatively wider.

Orthaea insularis sp. nov.

(Fig. 48)

Sparsely setose on head, pronotum and scutellum. Dull black. Hemielytra with somewhat more than anterior half, a preapical subcrescentic fascia and wide posterior margin of meta-pleura sordid whitish; remainder of the corium fusco-ferrugineous with the area near inner apical angle frequently ferrugineous. Membrane heavily infuscated, with a broad, pale patch at apex. Legs castaneous with the intermediate and posterior femora pale at base and the tarsi testaceous. Head faintly rugulose with fine appressed gray hairs, equally long as width across eyes, one-fifth shorter than anterior lobe of pronotum; tylus rufous, reaching midway on basal segment of antennae. Antennae testaceous, with terminal segment somewhat darker, second segment twice as long as first, third, one-third to one-fourth shorter, fourth segment very nearly as long as second. Rostrum castaneous, basal segment darker, apex of fourth segment reaching just past intermediate coxae. Pronotum with anterior lobe dull black, sparsely setose, twice as long and one-third narrower than the posterior lobe, the latter dark velvety-brown, anteriorly next to the sinus somewhat pruinose and there with a few scattered punctures; humeri concolorous; posterior margin very concave before the base of the scutellum. Sternum dull black with the posterior expanded margin of the metasternum white. Legs with the anterior femora much incrassate, more so in the male, armed except for a short distance at base with 8–10 short, stout teeth arranged somewhat in a double series; tibia and tarsi paler. Intermediate and hind legs with nearly basal half of femora and the trochanters whitish, remainder of femora and the tibia castaneous, with the tarsi sordid stramineous. Scutellum dull black, sparsely punctate, apical half depressed. Hemielytra with clavus fuscous at base and apex and provided with several rows of fuscous punctures; the inner longitudinal area sometimes smudged with fuscous; the anterior whitish part of the corium sparsely punctate with fuscous and with an abbreviated infuscated patch midway along the claval suture; the preapical crescentic whitish fascia reaching to the costal margin and provided with a few scattered fuscous punctures; the broad fusco-ferrugineous fascia sharply defined anteriorly and about the preapical fascia. Membrane dark smoky-brown, with the veins towards base and a broad patch occupying nearly the whole apex beyond the middle,

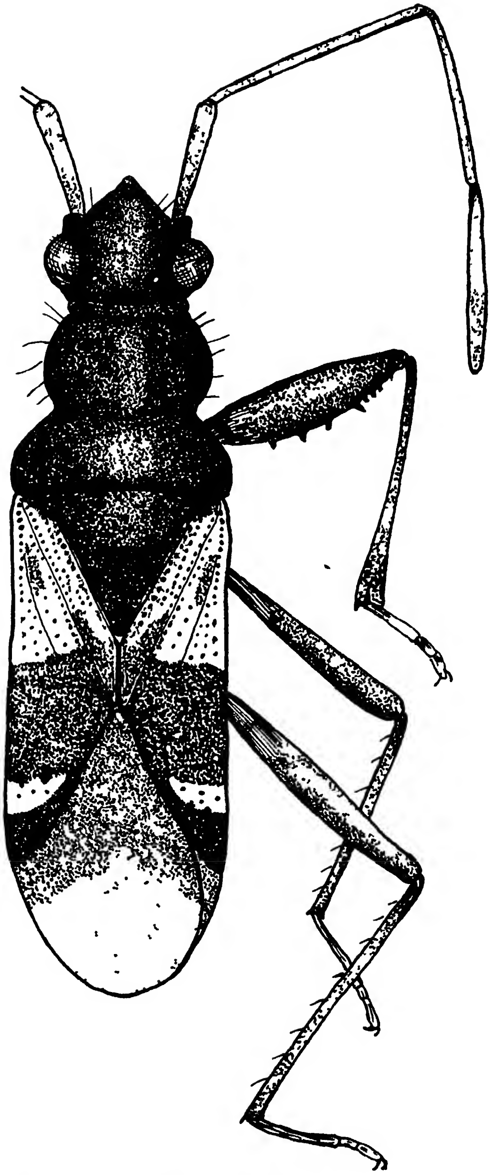

Fig. 48. *ORTHAEA INSULARIS* sp nov

pale. Venter shining castaneous with sparse covering of fine appressed hairs. Length 6.5 mm.

Type: Male and *allotype*, James Island, April 4, 1923. *Paratypes:* three males and nine females from James Island, male and female from South Seymour Island, female from Albemarle Island and two nymphs from Indefatigable Island.

This species is related to the dark form of *O. bilobata* Say, but is quite differently colored and marked. The anterior lobe of the pronotum in the male is relatively longer than in the female and often more swollen.

Family PYRRHOCORIDAE

Dysdercus concinnus Stål.

> *Dysdercus concinnus* Stål. Stål, *Ofv. Vet Ak. Forh* p. 198, 1861; *Enum. Hem.* I, *p.* 121, 1870. Distant, *Biol. Cent. Amer. Rhynch.* I, *p.* 231, *Pl.* 21, *figs.* 11, 12, 15, 1883. *Dysdercus mundus* Walk., *Cat. Hemipt. Br. Mus.*, V, *p.* 188, 1872.

A single specimen was taken on Indefatigable Island. It is a fairly common neotropical species not hitherto reported from the Galapagos Islands, in fact it is the only member of the family yet found there.

Family MIRIDAE

Creontiades fuscosus sp. nov.

(Plate 49)

Head, pronotum, scutellum, hemielytra anteriorly and posteriorly, antennae with basal segment, narrow base and apical third of second, first segment of rostrum, most of sternum and venter, femora and posterior tibia, dark brown or fuscous; posterior half of clavus and broad transverse area posteriorly extended along the costal margin, pale yellow-white.

Head shading to brown on the vertex, .75 mm. long, .8 mm. wide across the eyes; diameter of vertex very nearly equal to diameter of an eye; median longitudinal sulcus distinct; clypeus separated from the vertex by a distinct furrow. Antenna with basal segment .75 mm. long, second very nearly 2 mm., third 1.5 mm. and the fourth about .5 mm. long; the last two smoky-brown in color with the base of the third paler. Rostrum sordid stramineous, reaching to apices of posterior coxae. Pronotum somewhat shining, rugose, shading into paler brown on the disk, sparsely coated with fine appressed hairs, 1.5 mm. wide and 1 mm. long, lightly depressed behind and between the slightly evident callosities. Scutellum very distinctly transversely depressed before base, posterior to which the disk is quite convex. Hemielytra impunctate, with sparse fine coating of appressed pale hairs; apex of corium not reaching tip of abdomen. Membrane dark smoky-brown. Sternum and venter fuscous-brown. Coxae, trochanters, odoriferous orifices and outer margin of the meta-pleura stramineous. Anterior and intermediate tibia pale stramineous with a faint prebasal, premedian and apical band, brown; tarsal segments tipped with brown.

Length, male 4 mm.; female, 5.5 mm.

Type: female, Indefatigable Island; *allotype* topotypic. *Paratypes:* male, Indefatigable Island and female, James Island.

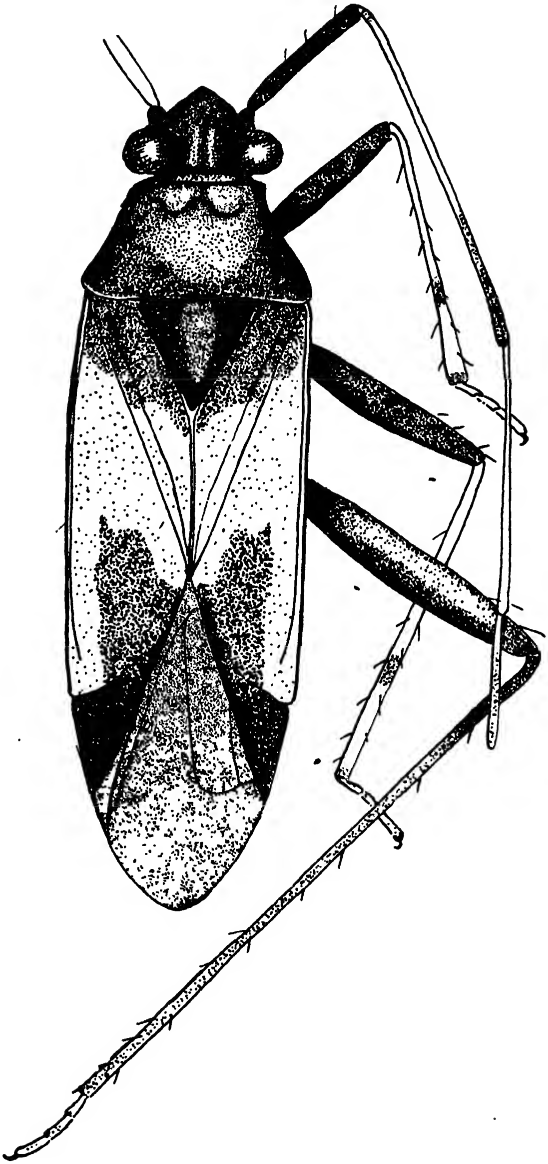

Fig. 49. ***CREONTIADES FUSCOSUS* sp. nov.**

I am indebted to Dr. H. H. Knight who has examined this and the following species and placed them generically for me.

Psallus insularis sp. nov.

Color sordid stramineous with sparse coating of depressed hairs, fringed with a few long hairs along the lateral margin of the pronotum. Head somewhat shining, nearly .25 mm. long and .5 mm. wide. Antennae a little dusky, short, with the two basal segments relatively stout; first segment reaching just beyond apex of the head, second segment .65 mm. long, third one-half the length of the second, the fourth a trifle over one-half the length of third. Rostrum, except at apex, pale, reaching to apices of posterior coxae. Pronotum .75 mm. wide and .3 mm. long. Scutellum with width equal to length, somewhat shining, frequently a little dusky. Hemielytra somewhat shining, with the costal edge nearly straight. Membrane lightly infuscated. Sternum and venter concolorous, pale. Legs pale, femora with a few fine black hairs beneath and tibia provided with a few short black setae. Tarsi, except at apices, pale.

Length, 2 mm.

Type: male, James Island; *allotype,* topotypic. *Paratypes:* three and eight females, James Island. The specimens are all in rather poor condition.

Family REDUVIIDAE

Repipta annulipes sp. nov.

Male moderately elongate, sparsely pilose, somewhat shining; stramineous in color. A broad fascia on the sides of the head before and behind the eyes, apices of the jugae and tylus, narrow rim about the ocelli, anterior pronotal tubercles, a broad fascia on the propleura, two subparallel fascia on the mesopleura meeting anteriorly, a single fascia on the meta-pleura, a broad longitudinal fascia along the sides of the venter continuous with the fascia of the pleura, the outer margins of ventral segments 2–5 posteriorly and the costal margins fusco-piceous. The posterior lobe of pronotum, bases of the four spines and two discal spots posteriorly on the anterior lobe and the hemielytra dark brown or fuscous. The antennae and legs are pale stramineous, the femora twice banded beyond middle with brown, the tibiae with two sub-basal bands and the apices brown.

Head equally long as the pronotum, shining, provided with two mediocre pale spines at base of the antenniferous tubercles, these not as long as one-third the length of an eye; postocular region a little longer than anteocular, much narrowed posteriorly to form a short collum, somewhat swollen behind the eyes, the sides lightly rounded and slightly converging posteriorly towards collum, the latter rather sharply set off. Antennae with basal segment stramineous, sparsely setose, three and one-half mm. long, slightly embrowned at apex; second segment slightly embrowned at apex, one mm. long, third segment slightly incrassate, narrowly pale at base, 5 mm. long, fourth segment brown, about 1.5 mm. long. Rostrum pale with little difference between the length of the first and second segments. Pronotum sparsely covered with incumbent grayish hairs, especially on the posterior lobe; anterior lobe shining, the deep

central longitudinal groove evanescent just before the anterior margin; the posterior lobe finely rugulose, the four spines mediocre but slightly longer than the preocular ones, pale at apices. Scutellum shining stramineous, produced into a short, somewhat elevated, acute process. Hemielytra brown with the costal margins infuscated, as on the posterior lobe of the pronotum, the surface has a sparse covering of incumbent grayish hairs, the apex sordid stramineous; the apical quadrangular cell over twice as long as wide. Membrane hyaline, extending well beyond apex of abdomen, the median vein embrowned. Connexival margins of abdomen unarmed. Venter sparsely setose, with a broad black longitudinal vitta placed nearer to lateral margin than to median line, this provided anteriorly on segments 2 to 5 with an oblique pale depression. Genital segment provided with a rather stout upwardly curved spine. Legs densely pilose.

Length, 11 mm.

Type: Male, Indefatigable Island.

Family NABIDAE

Nabis punctipennis Blanch.

One female, James Island, April 5. I follow Heidemann in the identification of this species. Without specimens for comparison it is impossible to be sure of the identity of this species. It certainly is very close to *N. ferus*.

Family TINGIDAE

Corythaica renormata sp. nov.

Pale cinereous, with antennae (only the two basal segments present) and legs pale stramineous. The following parts infuscated: hood dorsally, especially the areoles of it, a few of the veins of the paranota very faintly, the tumid elevation of the corium inwardly, costal areole and veins bounding it in the expanded part, a cross-vein at the rather abrupt termination of the arcuated part, the fourth cross-vein beyond this, all of the veins bounding the areoles along the posterior margin of the corium, broadly and those bounding the areoles of the membrane so broadly as to make these parts clouded; a pale translucent spot in the middle of the membrane occupying two large areoles.

Hood somewhat elongate, nearly twice as long as its greatest diameter behind the middle, acute anteriorly, rounded behind, provided with about seven sunken areoles, carinate in the middle; seen from the side it is more arched dorsally and does not extend so far forward beyond the head as in *C. carinata*. The lateral margins of the pronotum strongly elevated, compressed and strongly arcuated before the acutely produced, almost erect paranotal angles; these provided with only about four large areoles confined to the margins. The median carina a little longer than the hood, more arched before the middle, not more markedly elevated than the lateral carina and not distinctly areolate except for one or two large areoles in the widest part; the disk anteriorly embrowned, with large obscure shallow punctures, posteriorly to which the disk is provided with small, clean-cut punctures, the posterior prolongation obscurely areolate. Hemieleytra strongly, arcuately expanded

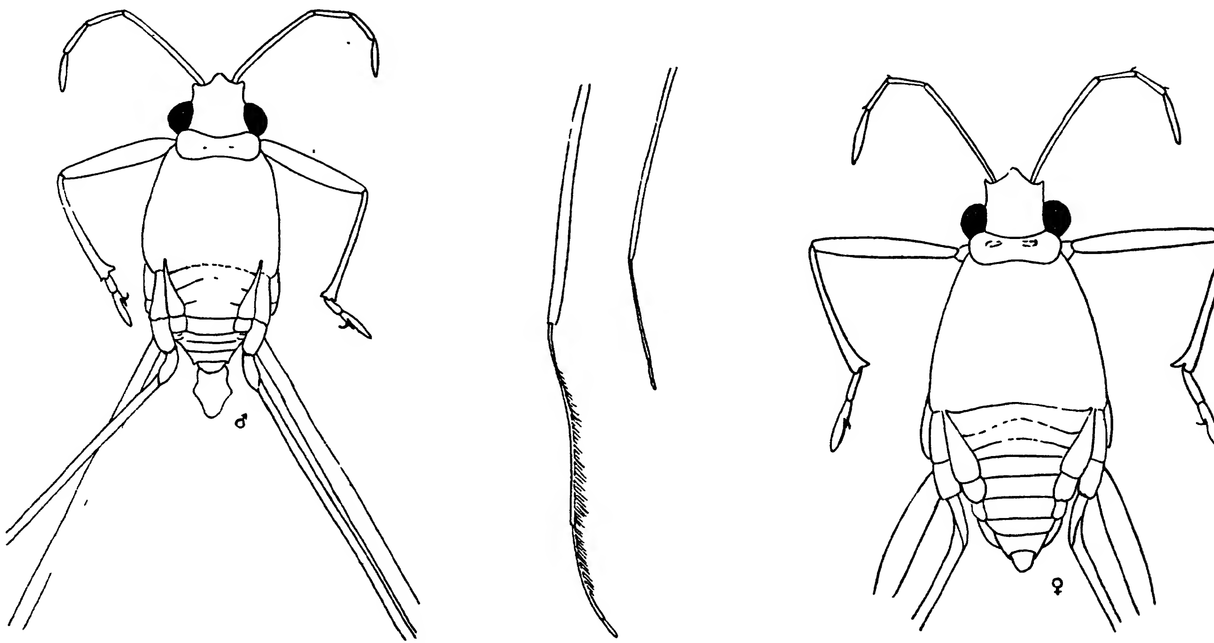

Fig 50. ***HALOBATES ROBUSTUS*** **sp. nov.**

***a*, male; *b*, female; *c*, middle and hind legs.**

one-third way from base, the costal area wide, provided with a single row of about sixteen areoles, a double areole just posterior to the widest part; the costal areoles are subquadrate anteriorly and posteriorly with the four cells just behind the arcuated part wider than long; the subcostal area with three irregular rows of shallow areolate-like punctures; the discal area very nearly equally long as the remainder of the hemielytra, provided with small shallow areoles, not as evident as in *C. planaris;* the tumid elevation is very pronounced opposite to the widest part of the hemielytra, almost evenly declivous anteriorly and posteriorly and provided with about three rows of areoles at the highest part. The membrane is provided with large areoles. Body beneath dark castaneous, with margins of bucculae and pleurae in part paler.

Length: 3 mm.; width of pronotum, .95 mm.; width of hemielytra, 1.15 mm.

Type. female, Daphne Major, April 24.

This differs from *carinata* in being relatively much wider with different shape of the hood and in the acute paranotal angles, etc. It is more closely related to *planaris* from which it can readily be distinguished by its narrower form, less expanded paranotal angles, less elevated pronotal carinae and differences in the arrangement of the areoles of the coastal region. Dr. C. J. Drake who has examined this specimen pronounces it as new.

Family SALDIDAE

Pentacora rubromaculata Heid.

Pentacora rubromaculata Heid. Heidemann, *Proc. Wash. Acad. Sci.* III, 368, 1901.

Only a single specimen was obtained.

Family GERRIDAE

Halobates robustus sp. nov.

(Fig. 50)

Form rather robust, widest across the apex of the mesonotum. Antennae and fore legs shining brownish black, with the usual coating of fine hairs; the intermediate and hind legs somewhat shining, brownish black, covered with fine hairs. Body black, slightly shining, densely coated with fine pale pubescence; on the sides and ventrally, with a much denser coating of fine incumbent hairs, giving a silvery white appearance to those parts. Base of the head between the eyes furnished with two oblique yellowish-brown fascia which do not quite meet in the central line. Dorsally with the posterior margins of the exposed abdominal segments narrowly and more or less distinctly yellowish-brown; ventrally with the posterior margins of these segments more distinctly bordered with yellow-brown and the first genital segment in the female is posteriorly and on the sides and the two genital plates of the second for the most part, yellowish; in the male the last genital segment is black.

The head is almost twice as wide as it is long; the apices of the antenniferous tubercles are rather acutely prominent but not extended quite as far forward as the median lobe of the head. The antennae are rather slender, almost two-thirds as long as the body, the first segment only a trifle shorter than the other

three taken together; length of the respective segments as follows: male, I 1.35 mm., II .5 mm., III .45 mm., IV .5 mm.; female, I 1.6 mm., II .6 mm., III .5 mm., IV .56 mm. The pronotum is four times as wide as long, just anterior to the middle with a shallow transverse depression on either side. The mesonotum abruptly widened in front just behind the pronotum from whence the sides are gradually rounded to the widest part just before the base of the middle legs; the greatest width in the male is 1.80 mm., in the female 2.30 mm.; in the male the dorso-ventral dimension is 1.22 mm., in the female 1.65 mm. The fore legs are rather stout with the apical tibial tooth well-developed; the length of the respective segments as follows: male, femur 1.6 mm., tibia 1.35 mm., tarsus .66 (first segment .165 mm., second .495); female, femur 2 mm., tibia 1.76 mm., tarsus 1.1 mm. (first segment .38 mm., second segment .72 mm.). The middle legs are 11.49 mm. long in the male and 12.31 mm. long in the female, with the greatest diameter .25 mm. one-quarter way from the base; the length of the respective segments is as follows: male, femur 4.67 mm., tibia 4.4 mm., tarsus 2.42 mm. (first segment 1.65 and the second .77 mm.); female femur 5.06 mm., tibia 4.5 mm., tarsus 2.75 mm. (first segment 1.98 and the second .77 mm.); the apical two-thirds of the tibia provided with a fringe of fine curved hairs over twice as long as the diameter of the tibia and agglutinated at their apices. The hind legs are much shorter and more slender, being about 6.71 mm. long in the male and 7.72 mm. in the female, with the greatest diameter .165 mm.; the relative length of the respective segments is as follows: male, femur 3.85 mm., tibia 2.2 mm., tarsus .66 mm. (first segment .44 mm., the second .22 mm.). The abdomen consists of the usual nine segments which may best be shown in the illustration.

Length: male, 3.85 mm., width 1.80 mm.; female, 4.5 mm., width 2.3 mm.

Type: male, Conway Bay, Indefatigable Island.

Allotype and 24 *paratypes* taken with the type.

This species seems most closely related to *sericeus* but besides its difference in size the relative lengths of the segments of the antennae and legs will serve to distinguish it.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."

Index

ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

INDEX TO

VOLUME VI

MARCH 1925–1925 JULY

NUMBERS 1–5 INCLUSIVE

PUBLISHED BY THE SOCIETY
THE ZOOLOGICAL PARK, NEW YORK

1927

STUDIES OF A TROPICAL JUNGLE

INTRODUCTION

By Henry Fairfield Osborn

The British Guiana Kartabo Station of the Department of Tropical Research of the New York Zoological Society was founded in January, 1916, after many conferences of Henry Fairfield Osborn, Theodore Roosevelt, Madison Grant and William Beebe. The site chosen was the district immediately around Bartica, British Guiana, in typical tropical rain forest, sixty-five miles from the coast and at an elevation of only twenty-five feet. The Station itself is at Kartabo, at the point of junction of the Cuyuni and Mazaruni Rivers, where intensive research work has been carried on in a quarter of a square mile of jungle and shore.

Under the directorship of William Beebe, five expeditions have been made into this field. There have been thirty-six months of actual work, covering every season of the year. Research work at the Station has been carried on by thirty-three workers from America, England, Scotland and France, and three hundred and six visitors have been entertained. One hundred and fifty contributions have been been published, including five bound volumes.

From the limited area under intensive investigation there have been collected notes, materials and specimens as follows:

(1) Life history notes on 73 species of mammals, 464 species of birds, 130 species of reptiles and amphibians, and 150 species of fish.

(2) Nests, eggs or breeding records of 206 species of birds, many new to science.

(3) Skins, skulls and skeletons of 60 species and 750 individual mammals.

(4) 1738 bird skins.

(5) 126 bird embryos.

(6) Hundreds of specimens of reptiles, amphibians and fish.

(7) 85,000 insects, of which one item alone is the types of eighty-seven new species of termites.

(9) 4,000 other invertebrates.

(10) 550 KOH specimens.

(11) 3000 photographic negatives.

(12) 22,000 feet of motion picture film.

(13) Specimens have been supplied to eight universities and five museums, while of living vertebrates there have been collected and sent to the New York Zoological Park 45 mammals, 215 birds, and 125 reptiles.

(14) The chief collections of amphibians, reptiles, mammals and many invertebrates have been presented to the American Museum of Natural History.

It is interesting, in view of this successful prosecution of research work in the tropics, to consider the actual cost of the entire undertaking. From the beginning to the year 1924 the total income has been $49,600. This has included the salary of the director, his assistant and chief artist, the steamship fares, entire scientific outfit, boats, tents, bungalow, household expenses, servants, hunters, taxidermists and the general accommodation for the staff of workers. The five expeditions have averaged six and a half months each, with an average of eight staff workers, the total average cost of each trip being $9,920.

OUTLINE

I—Geographical Position
- 1 Latitude and Longitude
- 2 Country, Rivers

II—Meteorology
- 1 Seasons
- 2 Rainfall
- 3 Humidity
- 4 Sunshine
- 5 Temperature
- 6 Wind
- 7 Comparison with Coast and Interior

III—Geology
- 1 Rocks, Minerals and Soil
- 2 Earthquakes

IV—Physical Character
- 1 Land: Altitude, levels, swamps
- 2 Tidal area and shore
- 3 Water: creeks, rivers, tides

V—Flora
- 1 Aquatic
- 2 Littoral
- 3 Jungle
- 4 Clearing

VI—Fauna
- 1 Protozoa
- 2 Porifera
- 3 Coelenterata
- 4 Platyhelminthes
- 5 Nemathelminthes
- 6 Trochelminthes
- 7 Molluscoida
- 8 (Echinodermata)
- 9 Annulata
- 10 Mollusca
- 11 Arthropoda
- 12 Chordata

VII—Historical

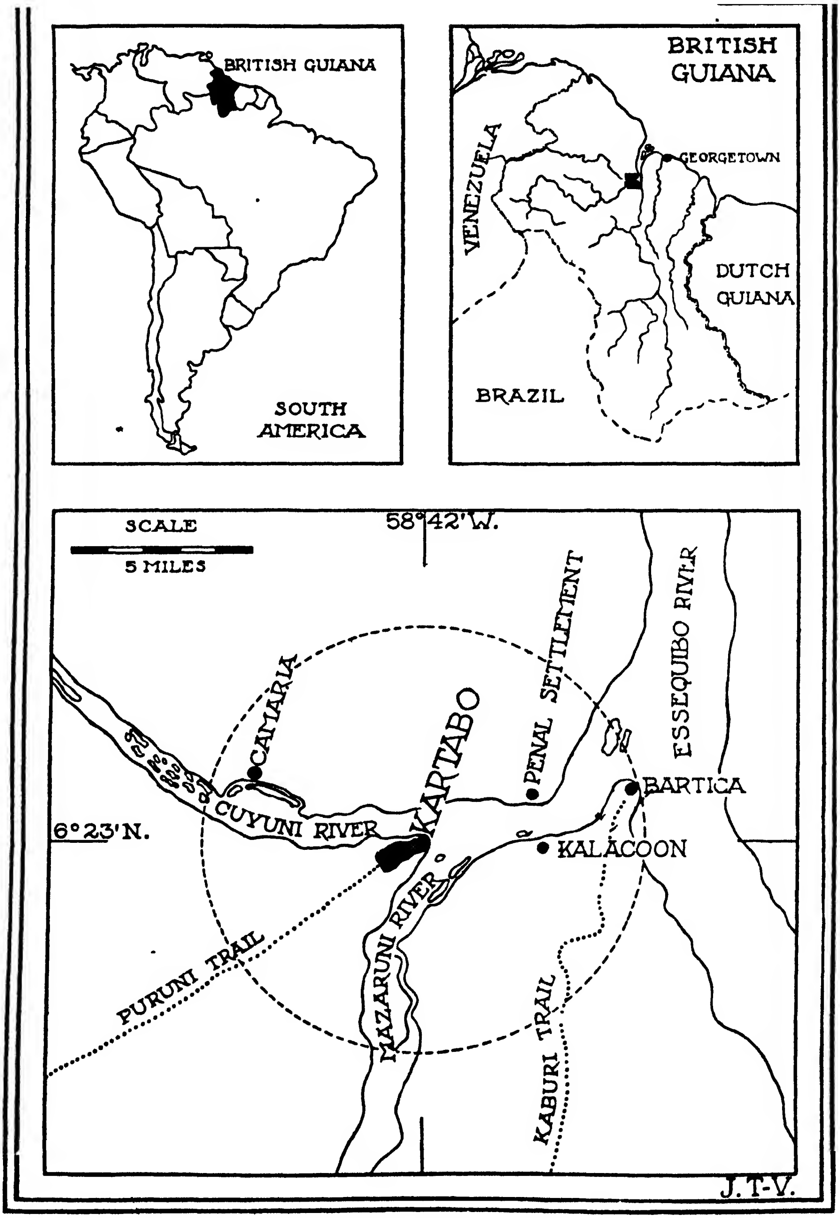

Plate A. British Guiana Tropical Research Station of the New York Zoological Society.
The circle represents a radius of six miles

STUDIES OF A TROPICAL JUNGLE;[1]

ONE QUARTER OF A SQUARE MILE OF JUNGLE AT KARTABO, BRITISH GUIANA

By William Beebe

(Plates A, B. Figs. 1–17 incl.)

This study of the environment or ecology of Kartabo is offered as a general survey of the region. Every fact in it is as true and correct as I can make it, but all estimates are underestimates. For example, the number of species of amphibians represents probably three-fourths of the actual autochthonus fauna; the mammals observed could certainly in time be increased by twenty-five per cent., and so on. This is in spite of the fact that several of us have spent five seasons of work here, but even in this limited area, the life of the opaque waters, and that under ground, in the lofty treetops and of the night must still hide innumerable forms from us.

This entire contribution outlines the more interesting and significant points of view which have presented themselves while I have been engaged in more specific, definite researches. It is intended as an introduction to the faunal papers which will follow in succeeding numbers of Zoologica.

I—Geographical Position

British Guiana, on the north-east coast of South America, is about twice as large as the State of New York. The Essequibo is the largest river of the Colony, and its most important tributary, entering at Bartica, is the Mazaruni. Six miles above this point, the Cuyuni joins the Mazaruni, and at the exact meeting point is Kartabo, the site of the Tropical Research Station of the New York Zoological Society.

The Cuyuni winds for two hundred and fifty miles in a general north-west direction and rises somewhere in the wilderness heart of Venezuela; the Mazaruni, through one of its tributaries, twists and turns through an equal distance of gold and diamond country, and drains the very slopes of the mighty plateau of Roraima, on the Brazilian frontier.

Kartabo, then, is in the north-central part of British Guiana, and its position relative to the three great rivers is such that its exact location is indicated on even the smallest of continental maps. Its position on the earth's surface is 58° 42′ West Longitude, and 6° 23′ North Latitude.

[1] Contribution, Department of Tropical Research No. 190

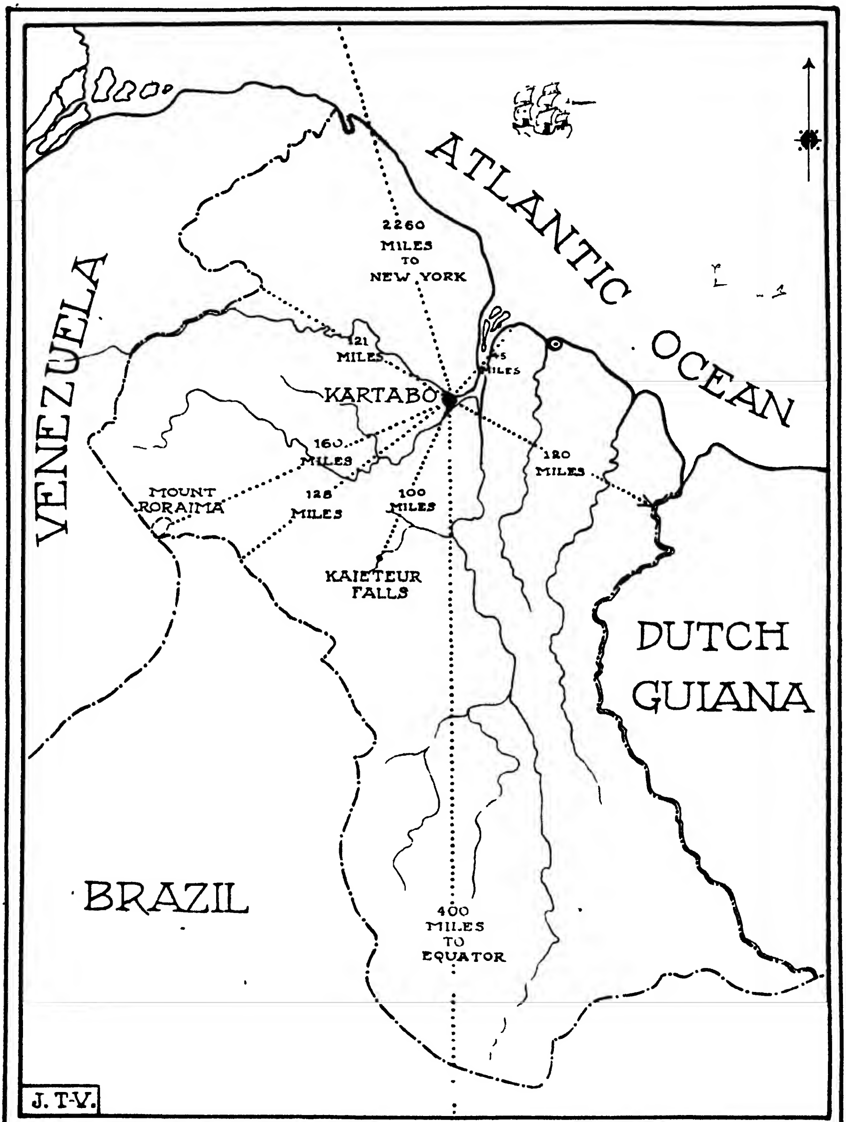

Fig. 1. Orientation Map of Kartabo.
Drawing by John Tee-Van.

The following distance lines of radiation may prove an additional help in the orientation of Kartabo:

The Atlantic Ocean is forty-five miles NNE.
The Dutch Guiana frontier is 120 miles SE.
The Equator is 400 miles S.
Kaieteur Falls are 100 miles SSW.
The Brazilian frontier is 128 miles WSW.
The plateau of Roraima is 160 miles WSW.
The Venezuelan frontier is 121 miles WNW.
New York City is 2200 miles NNW.

As may be seen by the accompanying map, a circle with a six mile radius from Kartabo includes Bartica and the banks of the Essequibo, together with the Mazaruni and the Cuyuni up to their first falls and rapids.

The general research work has been carried on within the black area at Kartabo. *Unless otherwise stated, the following account of this region, and the various articles which will follow in future numbers of Zoologica, dealing with more definite, intensive researches, refer altogether to this tract of land and water, measuring less than two thousand by four thousand feet, at the very point of juncture of the Cuyuni and Mazaruni Rivers—an area one-quarter the size of Central Park in New York City, or, to use a less local simile, a square of land measuring ten average city blocks on each of the four sides.*

This limited field of intensive research is the most important factor in the work carried on at the Station, and presents tropical abundance of life with a vividness which transcends any generalizations or statements based on less definite grounds.

II—Meteorological Conditions

Kartabo, British Guiana

Introduction

Accurate records of weather conditions have been kept for many years at His Majesty's Penal Settlement, three miles N. E. by E. from Kartabo, on the north shore of the Mazaruni River, the station being fitted up as a Normal Climatological Station of the Second Order of the International Classification. Records of rainfall are taken at The Hills Plantation, three-quarters of a mile from Kalacoon, the first home of the Tropical Research Station. The Hills Plantation is situated on the south shore of the Mazaruni River, directly opposite the Penal Settlement.

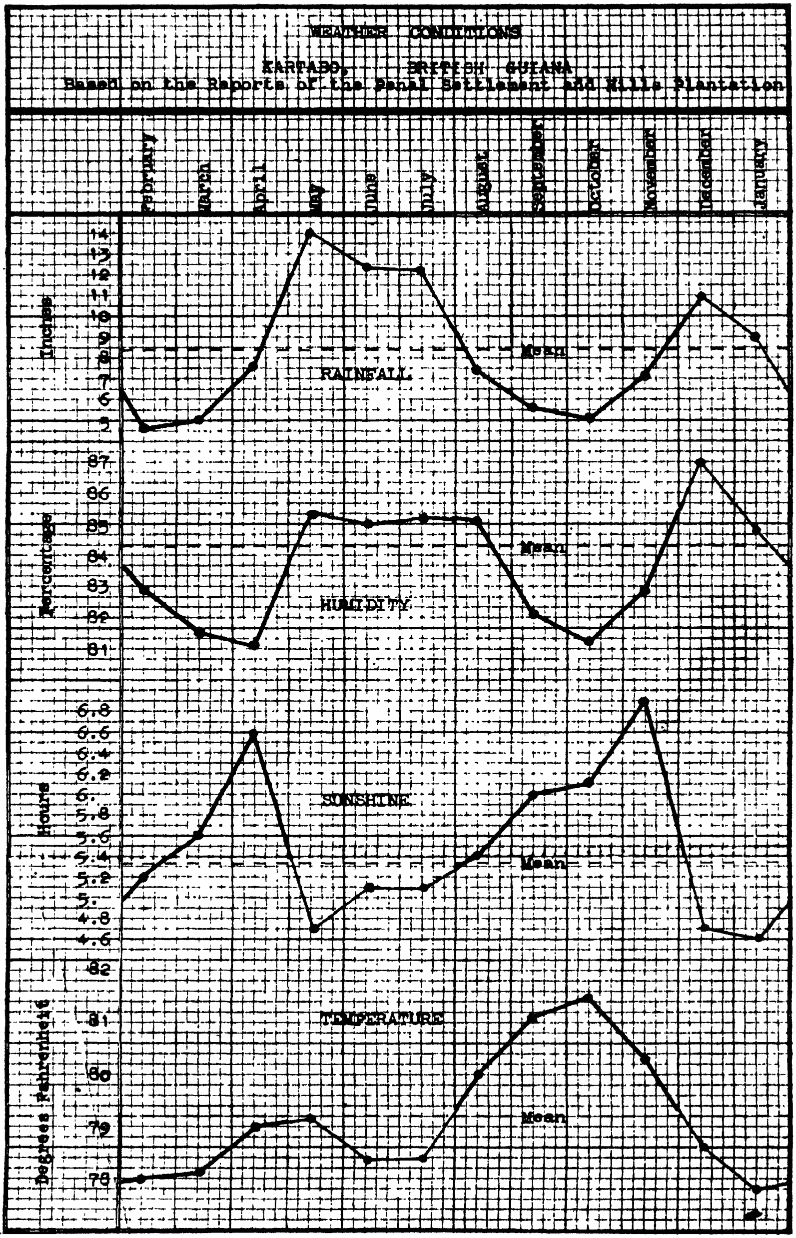

Fig. 2. Variations of weather conditions, Kartabo, British Guiana.

Thus, the two stations, Penal Settlement and The Hills Plantation, form the base of the triangle of which Kartabo is the apex. Both places are approximately three miles down river from the Station at Kartabo, and are separated from each other by about three-quarters of a mile.

The reports of these two stations may be taken as representing the weather conditions of Kartabo, and the immediate vicinity, some records extending back twenty years. The following statements and charts are entirely based upon the published and unpublished records of observations of these climatological stations.

Seasons

Although the beginning and ending of the seasons cannot be stated in exact terms of weeks or days, the following four divisions are recognized as distinct:—

Short Dry Season—February, March, April.
Long Wet Season—May, June, July.
Long Dry Season—August, September, October, November.
Short Wet Season—December, January.

Adopting these seasons, the rainfall in inches and percentage is given in the following tables:—

Seasons

Number of Inches and Percentage of Yearly Rainfall

Short Dry Season	17.05 Inches	16.8 per cent.
Long Wet Season	38.84 "	38.4 " "
Long Dry Season	25.27 "	25.2 " "
Short Wet Season	19.81 "	19.6 " "

Adding the rainy and dry seasons together as single seasons we have the following figures:—

Rainy Seasons	58.65 Inches	58.0 per cent.
Dry Seasons	42.32 "	42.0 " "

Roughly speaking, three-fifths of the rains are to be found distributed through the five months assigned to the rainy seasons, and the other two-fifths to the seven months of the dry seasons.

This gives an average of 6.04 inches rainfall for the dry months, and 11.73 inches for the wet months.

Rainfall

The average annual rainfall is *100.53* inches. The months average as follows:—

February	4.55	inches
March	4.94	"
April	7.56	"
May	14.00	"
June	12.44	"
July	12.40	"
August	7.40	"
September	5.56	"
October	5.19	"
November	7.11	"
December	10.93	"
January	8.87	"

The list of months given their position according to greatest rainfall becomes:—

May	April
June	August
July	November
December	September
January	October
	March
	February

The available data, as to the number of days upon which rain falls, show an annual average of two hundred and nineteen days or fifty-nine per cent. of the whole year.

During 1920, May and June each had twenty-seven days upon which rain fell, while February, the lowest month, had six days. The highest recorded annual rainfall is 117.75 inches in 1918, and the lowest 77.11 inches in 1911. The highest rainfall for a single month was in May, 1918, 22.34 inches, and the lowest occurred during February, 1912, a year of drought, and was .03 inches.

Humidity

The available records for humidity show observations taken three times a day, at 7:00 A.M., 1:00 P.M. and 6:00 P.M.

The following table gives the mean of these observations:—

7:00 A.M.	90.9	per cent.
1:00 P.M.	79.0	" "
6:00 P.M.	82.2	" "
Average	84.2	" "

The following table gives the average of the humidity by months:—

February	82.9	per cent.
March	81.5	" "
April	81.1	" "
May	85.3	" "
June	85.0	" "
July	85.2	" "
August	85.1	" "
September	82.1	" "
October	81.2	" "
November	82.9	" "
December	87.0	" "
January	84.8	" "
Yearly average	84.2	" "

Sunshine

Available records for sunshine show the following monthly averages:—

February	5.5	hours
March	4.3	"
April	5.1	"
May	4.0	"
June	5.2	"
July	4.2	"
August	6.2	"
September	6.8	"
October	6.7	"
November	6.3	"
December	5.5	"
January	4.6	"
Average daily sunshine	5.3	"

The maximum amount of sunshine for a single day was 11.6 hours on July 30, 1920.

Temperature

Available records of average shade temperature are as follows:—

February	78.0° Fahrenheit
March	78.1° "
April	79.0° "
May	79.2° "
June	78.4° "
July	78.4° "
August	80.0° "
September	81.1° "
October	81.5° "
November	80.3° "
December	78.6° "
January	77.8° "
Average shade temperature	79.2° "

Placing these months in order, lowest temperatures first, we have the following list:—

January	April
February	May
March	August
June	November
July	September
December	October

The mean, maximum and minimum shade temperatures are as follows:—

	Fahrenheit			
February	82.8°	maximum	73.3°	minimum
March	83.2°	"	73.1°	"
April	83.8°	"	74.2°	"
May	83.2°	"	75.1°	"
June	82.8°	"	74.1°	"
July	83.3°	"	74.0°	"
August	85.0°	"	75.2°	"
September	86.5°	"	75.5°	"
October	85.2°	"	75.6°	"
November	85.9°	"	74.8°	"
December	83.5°	"	73.8°	"
January	82.5°	"	73.2°	"
Yearly average	83.9°	"	74.3°	"

Wind

The Station and the research area at Kartabo are located upon an open expanse of four miles of water facing almost due east, so that full advantage is gained from the trade winds, which blow prevailingly from the east, with northeast winds a close second. These breezes from the sea, forty-five miles away, blow almost steadily during the day throughout most of the year, while during January, February and March they continue through much of the night as well.

Occasionally, during the rainy seasons, the wind blows for a short time from the continental side, southeast or even south, and brings with it the heaviest falls of rain.

The wind is remarkably even throughout the year, as shown by the accompanying tables, and varies from "Gentle" to "Fresh" with very few gales and no hurricanes.

Moderately severe thunder storms occur now and then, especially during the changes in the rainy seasons.

The table below gives the average for observation taken upon the force of the wind three times daily:—

February	3.5 miles per hour
March	3.3 " " "
April	2.7 " " "
May	2.5 " " "
June	2.9 " " "
July	3.1 " " "
August	3.7 " " "
September	3.6 " " "
October	3.8 " " "
November	3.2 " " "
December	3.1 " " "
January	3.6 " " "

Summary

Seasons — *Two Dry Seasons* occupying seven months of the year, February, March, April, and August, September, October, November; within which two-fifths of the rains fall.

Two Wet Seasons occupying five months of the year, May, June, July, and December, January; within which three-fifths of the rains fall.

In ecological researches at Kartabo, the more natural method is followed of beginning the year with February, the first month of the Short Dry Season.

Rainfall	Average, 100.53 inches (annual). Heaviest—May, followed in order by June, July, December, January. Lowest—March, February.
Humidity	Average, 84.2 per cent. Average 7:00 A.M., 90.9 per cent. 1:00 P.M., 79. " " 6:00 P.M., 82.2 " " Month of greatest humidity—December. Month of least humidity—April.
Sunshine	Average, 5.3 hours daily. Greatest sunshine—November, April. Least sunshine—January, December, May.
Temperature	Average, shade temperature, 79.2° Fahrenheit. Coolest months—January, February. Warmest months—September, October.
Wind	Prevailing Direction—*East* to *Northeast.* Average rate of speed—3.25 miles per hour.

Meteorology of the Coast-lands and the Far Interior Compared with Kartabo

Along the flat, alluvial coastlands, records of weather conditions are taken at many places, the most important meteorological weather station in the Colony being situated at Georgetown. Rainfall and other records have been taken at this Station since 1846, and the figures used are the averages for the available records of this period. The reports show that "the climate at Georgetown is a very equitable one, and one which . . . varies regularly and equitably."

In the far interior on the savannah country of the plateau regions, records are taken at Eupekari, and at Dada-nawa, both on the Rupunnuni River. Dada-nawa is situated about two hundred and fifty miles southwest by south from Kartabo, at 2° 49′ 25.5″

north latitude, and 59° 29′ 29.3″ west longitude. Eupekari is nearer Kartabo, about 195 miles in the same direction as Dada-nawa, and is at approximately 3° 40′ north latitude and 59° 18′ west longitude.

At Dada-nawa the records show that the rainfall is far less regular than at Kartabo, and that it averages lower than the coast-lands, and much lower than the forested region within which Kartabo is situated. The temperature at the savannah stations also has a greater range, the maximum being higher and the minimum lower than at any of the coast stations.

Meteorology of Kartabo
Compared with that of the Coast-lands and the Far Interior

	Coast Lands	Kartabo	Interior Stations
Rainfall	94.37 inches	100.53 inches	51.88 inches
Humidity	78.1 per cent.	84.2 per cent.	86.5 per cent.
Temperature	80.4° Fahr.	79.2° Fahr.	83.1° Fahr.

III—Geology

The Colony of British Guiana may be divided into three transverse zones: First, the narrow, flat, alluvial coast-land much of which is actually below high tide level, and which never exceeds an elevation of ten feet, and along the Essequibo River reaches about twenty miles inland. Second, a zone of sedentary sand and clay, in which Kartabo is situated. This lies back of the low coastal region, and extends clear across the Colony. The origin of the sand and kaolin is given later. This zone is one of low elevation, from fifteen to two hundred feet, and is of greatly varying width. The country is undulating and is generally covered with high, tropical rain forest. Third, the mountain zone consisting of undulating plateaus, rising successively from one thousand to twenty-five hundred feet, occasionally cut into deep gorges as the eight hundred and ten foot fall of Kaieteur, and culminating in the flat-topped plateau mountain of Roraima, five thousand feet above the surrounding country and eighty-six hundred feet above the sea.

Rocks, Minerals and Soil

At low tide, a considerable extent of rock appears at Kartabo

Point, extending along the shore from B_6 south to C_5. Again farther south at Boom-boom Point, I_1 and I_2, and J_1 and J there is a great massive outcropping. Of these rocks Sir John Harrison writes that they "consist principally of grey granite but pegmitite or giant-granite is present in abundance. In places good specimens of graphic granite may be obtained. Mica is present in the giant-granite, sometimes in large plates, while here and there red garnets are fairly abundant in the pegnatite veins. A little to the westward the medium-textured light-gray granite is seen with a glistening darker-colored, fine-grained rock apparently intrusive in it. Both are traversed by veins of coarse pegmatite, which in places contain garnets. The fine-grained rock is seen, on microscopic examination, not to be an intrusive igneous rock, but a clastic sedimentary rock caught up in, and intensely metamorphosed by, the granite."

The gray granite almost at the very door of the Research Station represents the basic foundation of earth structure, the very skeleton of the planet, fashioned in planetary flame, upon which the other rocks rest, over which the rivers flow, and standing as a contrast to the evanescent plant and animal life existing upon its great masses.

The granite at Kartabo and near-by points is the largest outcropping in the Colony. Harrison describes it in detail as containing large irregular plates of orthoclase or potash felspar, in places with albite or milky-white felspar, numerous small plates of microcline and abundant ones of oligoclase. The felspars contain some inclusions of small granules of epidote and minute flakes of secondary muscovite, and irregular patches of quartz. The micas are in the form of large plates of muscovite and flakes and wisps of greenish biotite. A few grains of sphene, rarely minute crystals of zircon and some granules of iron-ore are present.

The dominant inorganic character of the research area consists of sands and clays, residual deposits in distinct contrast to the fluvio-marine deposits of the alluvial coastal zone. The rapidity of disintegration of exposed granite in this region is almost unbelievable, breaking down into deposits which are distinguished from finely divided fluvio-marine matter by the relatively great abundance of heavy minerals in the former. Aplite, granite, pegmatite, quartz-porphyries, the more acidic granitites, and the gneisses and schists derived from them give rise to more or less sandy kaolins and pipeclays, varying in color from white to cream. The beach in

front of the Station consists of white quartz sand overlying firm deposits of creamy-white kaolin. The rocky bank back of this is seen in the process of actual erosion and disintegration. In these deposits from metamorphosed granites muscovite is present in abundance together with small crystalline grains of corundum. In addition to these tourmaline, topaz, beryl, garnet and spinel are found. At Kartabo the inorganic factor in the ecology is a relatively unimportant one, but within short distances metals and minerals are of the utmost importance. Thirty-five miles to the southeast thousands of tons of kaolin have been mined, for the bauxite derivative of the contained alumina; in the Kartabo sand are occasional flakes of gold, while fifty miles to the west paying gold diggings begin, culminating in a spot like Omai, sixty-five miles to the south where from an area of sixty acres over ninety-five thousand ounces of gold have been taken. The diamond fields are no farther away.

At first only a few stray stones were found, but today the diamond-bearing area includes three thousand eight hundred square miles. During the first twelve months of 1923, 1,141,425 diamonds were found, aggregating 214,475 carats. The largest stone weighed 48 1/8 carats and was found on the right bank of the Kurupung.

Gold mining began in the Cuyuni in 1863, but no great amount was taken out until 1886. The largest nugget found weighed 28 oz. 10 dwts.

Earthquakes

Earthquakes are felt now and then, usually slight and transitory occasionally more severe and with appreciable effects. One of these occurred on May 10th, 1922 at 3:00 A.M., lasting about twenty seconds, travelling from East to West. The laboratory was severely shaken, trees were loosened, and large amounts of earth slipped down along steep banks of the river and inland gullies.

During seven years, six rather severe shocks have been recorded:—

March 26, 1915	12:25 A.M.	
March 29, 1915	7:00 P.M.	
February 24, 1918	7:20 P.M.	
May 31, 1921	4:30 to 5:00 A.M.	Two shocks.
May 10, 1922	3:00 A.M.	

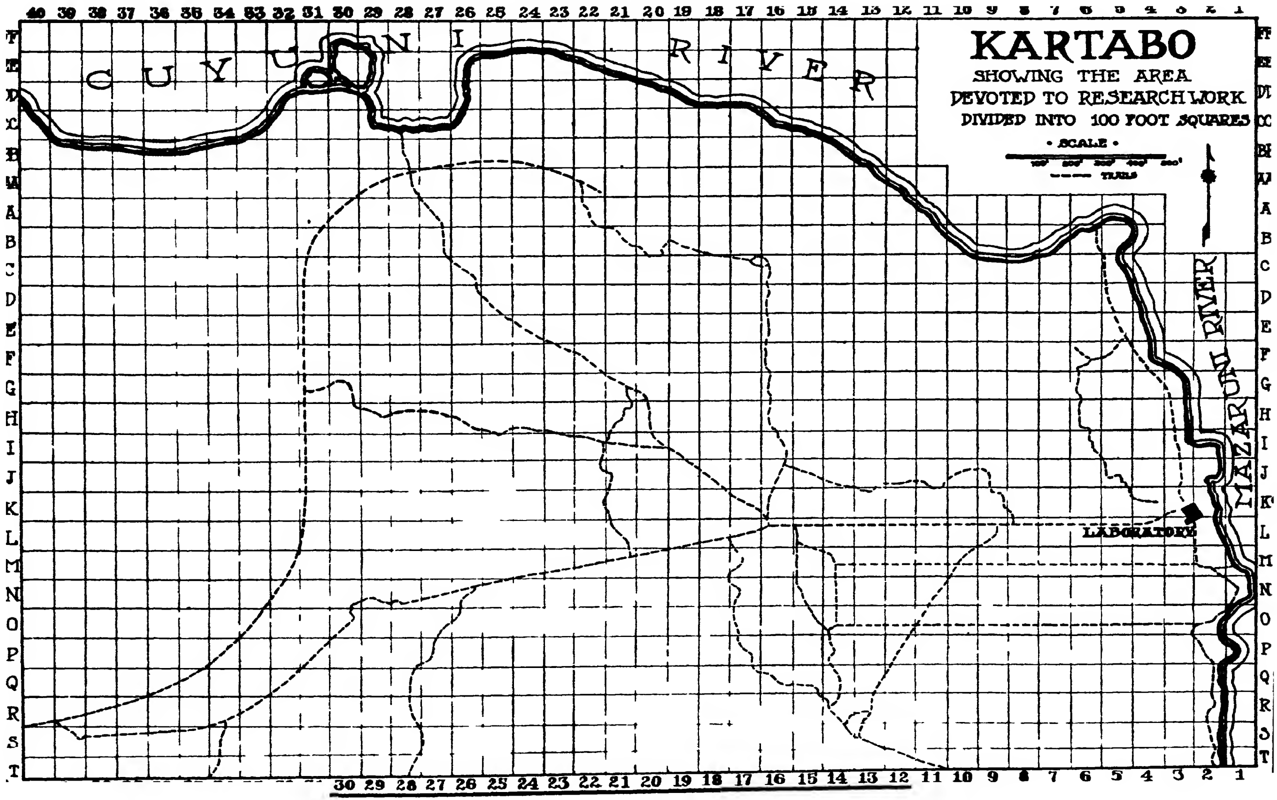

Plate B Area devoted to research at Kartabo.
Drawing by John Tee-Van

IV—Physical Character

Kartabo, British Guiana

Within the approximately quarter of a square mile devoted to research work at the Tropical Research Station, the average height of the land mass may be placed at between thirty and fifty feet above the mean tides.

Along the shore of the Mazaruni River, immediately surrounding the laboratory, the land is flat, averaging about five to fifteen feet above the mean level of the river. Three hundred feet west of the laboratory, and about four hundred feet from the river, the land rises sharply, forming a rounded hill about eighty feet in height, two to three hundred feet through at the base; continuing westward, expanding laterally, until in the western end of the research area it becomes over a third of a mile wide. The northern aspect slopes abruptly downward, while the slope on the southern side is very gradual, occupying about two-thirds of the width of the entire hill. This hill forms the beginning of the divide between the Mazaruni and Cuyuni Rivers, extending southwestward, becoming higher and joining the southernmost extension of the Oko Mountains, thirty miles away.

In the northwestern portion of the research area the hill nearly meets the shore of the Cuyuni River, while to the north and northeast are found swamps and moist lowlands. Southward of the hill rolling lowlands predominate, and swamps are fewer in number and less in extent. The majority of the swamps are formed by the rains, and rarely by springs or underground seepage of water.

Tidal Area and Shore

The shore area of the rivers influenced by tides is extensive and varied, occupying approximately six thousand linear feet, divided into the following:—

Rocks	300 feet
Sandbeaches	650 feet
Shore steep, edge of jungle, tree roots merging with tidal area	1200 feet
Shallow, mud and sand-bottomed flats	3850 feet

On the northern boundary of the research area from BB_{16} to DD_{32} on the Cuyuni River, the shore is shallow, with many rocks

scattered about on the mud and sand of the bottom. Jungle trees come to the edge of the water, their roots often forming an intimate portion of the tidal area,—the water lapping over many feet of their buttressed supports.

From DD_{32} eastward to about EE_{22}, the area including the two Cuyuni Islands and Emerson Bay, the tidal area is small and the shore drops away rapidly. Trees come to the edge of the water, but mangroves and a consequent shallow shore are not present, due mainly to many swirling whirlpools within the bay, and to the currents of the Cuyuni on the outer portions, which at this point are very swift. There is much rock to be found on the shores of the two islands, especially about the easternmost larger one. This rock is continuous with a line or rocks which project northward for two to three hundred feet, partially exposed at low water. The remainder of the Cuyuni shore from EE_{22} to the easternmost portion of B_7 is shallow and shelves slowly, most of the bank being covered with mangroves.

The point of land which marks the dividing line between the Cuyuni and Mazaruni Rivers has an extremely small tidal area, and is formed of rocks descending sharply into deep water.

Passing around the rocks at the point of land to the Mazaruni side of the research area, the tidal space is first formed of coarse whitish-yellow sand (B_5 to E_4), shelving rapidly on its northern end, and merging to the south with shallow mud and sand bottom banks covered with mangroves; this shore descends very slowly into the deeper portions of the Mazaruni (E_4 to H_3). A large outcropping of gray granite forms the next portion of the shore, bare and forbidding in appearance (I_2, J_2), with many sharp, jagged pieces on the mud and sand bottom, which is continuous with the remainder of the shore.

To the south of these rocks (J_2 to M_1) is the beautiful, three hundred foot long sand beach, which extends in front of the laboratory. This beach is mainly formed by the breaking down of the fifteen foot cliff-like bank of clay and sand in front of the station. It is continuous with the great bank of coarse, yellowish-white sand which extends down river for over three-quarters of a mile from the laboratory. This bank has been formed by the constant swirls and eddies caused by the meeting of the two great rivers. During very low tides, it is possible to walk down stream for over half a mile, without finding more than two feet and in many places only six inches of water.

Below the sand bank another group of gray granite rocks are found (N_1), followed by a steep, yellow clay bank (southernmost part of N_1 and northernmost part of O_1), fifteen feet high extending for about fifty feet. This borders on shallow sand and mud flats which abutt on jungle trees and tree roots, and extends to the southeastern end of the area devoted to research work.

Water

The area at Kartabo devoted to research is bounded on the north by the Cuyuni River, which at this point is not quite half a mile wide (2500 feet), and on the east by the Mazaruni River, whose nearest point on the opposite shore is nearly a mile and a quarter away (6350 feet).

The tides on these huge rivers are swift, the downward current running from one to three miles an hour. The average rise and fall amounts to from six to six and a half feet. During seasons of high water at full moon tides the waters are often six to eight feet higher than the usual high tides. Five miles above Kartabo the tides in both rivers end, as at that point the first rapids are found.

At Georgetown and at the mouth of the Essequibo, forty-five miles downstream from Kartabo, the tides average about two and a half hours earlier than they do at the station.

The time occupied in rising and falling is influenced greatly by the amount of water flowing down from the upper reaches of the rivers. The difference sometimes varies to the extent of a falling tide of nine hours and a rising tide of two and one half hours.

The color of the water is a pale brown, mainly caused by the stains derived from the leaves of the wallaba tree (*Eperua falcata* Aubl.). At 8:30 A.M. with the sky half covered with clouds, the color in the shade approaches nearest to olive-brown (Ridgway). But the influences of shade and depth are such that the water appears to have a greenish tinge instead of reddish. Lowering a white disk six inches in diameter into the water, the color is quite yellowish at the surface, becoming browner farther down, and near the point at which it disappears acquires a distinct orange tone.

Experiments at 8:30 A.M. give the following color values, as compared with Ridgway's "Color Standards and Nomenclature," observed over a six inch white disk at different levels:—

Surface........................White

1 inch	Cartridge Buff
2 inches	Colonial Buff
3 inches	Deep Colonial Buff
4 inches	Warm Buff
5 inches	Antimony Yellow
6 inches	Dull Capucine Orange
12 inches	Zinc Orange
15 inches	Vinaceous Fawn
18 inches	Russet Vinaceous

From eighteen inches downward the colors become darker and darker, and at twenty-five inches the disk disappears from view. This depth of twenty-five inches at which the disk disappears is to a great extent independent of the position and intensity of light from the sun, and is brought about almost entirely by the amount of stains and coloring matter held in suspension by the water. Experiments with the sun directly overhead, or at an angle of 30 to 35 degrees give the same result,—a blocking out of the disk at twenty-five inches.

Occasionally during heavy rains about the upper portions of the rivers, quantities of brownish yellow coloring matter, in appearance much like the yellow-brown Amazon mud carried in suspension by the sea along the coast of Guiana, is brought down. During the second and third weeks of May, 1922, the waters of the Cuyuni were deep brownish-yellow, quite opaque, so much so that one's hand disappeared from view six inches below the surface. The difference between the clear waters of the Mazaruni and the colored water of the Cuyuni was especially noticeable at Kartabo.

On the sand beach in front of Kartabo, the temperature of the water below the surface and near the bottom averages 79–80 degrees Fahrenheit.

Within the area devoted to research there are a few small streams, which disappear to a great extent during the dry season. At the northwestern portion of the research area is a single larger creek about ten feet across.

V—The Flora of Kartabo

The flora of Kartabo has been studied by no competent general botanist, and in this résumé I have attempted nothing but an indication of the more conspicuous and abundant growths, particularly

those which possess an important relationship with members of the vertebrate fauna, either in the way of food, homes or media of support and progress.

Fluviatile

Blue-green, red and brown algae and diatoms are abundant but no collections have been made of them. Very remarkable purple algae have been found in the stomachs of puffers but not observed elsewhere. Both the two- and three-toed sloths have the well-known peculiar green algae growing on the dorsal hairs.

Littoral

The littoral flora is sharply delimited to between tide marks. Where the current is swift near shore, these forms are almost hidden by overhanging vines and lianas, dependent from the high jungle trees which crowd down to the very water. Along sandy and sloping muddy shores they are spread out, but even in such places do not extend more than a few yards from the high tide mark. Specific associations are well marked in the littoral flora, solid cultures of mangroves, sedge, mucka-mucka and others.

The mangroves, *Rhizophora mangle* Linné, find root-hold in certain definite areas of the gently sloping mud-flats, feeling their way far out, with long steps, foliage held high out of reach of the water. They are in no sense shore builders, they do not attempt to stay the tide, but allow it freedom to wash back and forth.

Back of them, on firm mud and sand, the tall graceful sedges live out their half aquatic, half aerial lives. The two dominant species are the White-plumed Sedge, *Eleocharis geniculata* R. Br., and the Starry Sedge, *Cyperus* sp. The former are gigantic in favorable spots, with their triangular, forest-green stems reaching up twelve feet, while the latter present lowlier clumps topped with the fluffy white catkins. This one grows in denser clumps and is a better land holder, but the roots do most of the work. The stems survive the wash of waves by their pliability, giving instead of breaking.

In spots where the current is not too swift or waves too violent, appear rank upon rank of that aroid lily with the incongruous name of Mucka-Mucka, *Montrichardia arborescens* (Linné) Schott. The tall stout stem sends off great arrow-heads of leaves, and occasionally

Fig. 3. Mangrove beach at Kartabo.
Photograph by John Tee-Van.

a large white calla-like lily and later the pineapple fruit. Here and there are small patches of Horse Tails, *Equisetum,* hinting of epochs long since past. In 1919, these were confined to an area of not more than two square yards. Two years later this particular section had been washed away and I have found no further trace of these plants.

Clustering around the sedge clumps, like dug-in outposts, are the low, white-flowered *Diodia,* creeping along the sand and helping the coarse grasses to cling to the shifting grains. The most conspicuous flower stalks of the fore-shore are the tall Shore Gentians, *Coutoubea spicata* Aubl., which hold up their racemes of pinkish-white flowers well below high tide level. Their roots go deep and after a severe storm they seem to suffer less than some of the stronger growths.

One of the most valuable shore-binders is the rush-like herb, *Xyris tenella* Kunth. Hundreds of these little grassy-leaved plants take root beneath the mangroves and their roots mat together while their tall, clubbed-top stems rise bravely and expand tiny yellow blooms. With them occur the straggly, jointed stems with the inconspicuous pea-like flowers of *Vandellia difusa* Linné.

Very numerous, but so tiny and fragile that only close examination reveals their existence, are Utricularias bearing minute yellow blossoms.

On beaches of pure sand, fronting disintegrating, soil-covered banks, the plant association is of another character, all uniting to hold fast to as much as possible of the granitic talus which now and then slides down in sandy avalanches. Such is the beach directly in front of the laboratory.

Every inch of the precipitous bank which offers foothold is covered with representatives of the clearing flora,—the pink and white Mazaruni primroses, *Sipanea pratensis* Aubl., being the only bright color note.

At the foot of the bank the force of the tides is felt and the plants are no longer the gentle growths of a summer meadow, but must be sufficiently virile to hold their position against water and wind. As opposed to the mangrove zone, the dominant plants here are grasses. Close to the bank clumps of great, coarse beach grass, *Panicum* sp., sprout, with stems bent, but measuring ten feet in length. Farther down shore are creeping grasses, *Courmelina longicaulis* Jacq., whose stems seek safety by allowing themselves to become half buried in the sand, with leaf tips coming up for breath.

These are perhaps the best sand-binders, and given half a chance will form a mat of their interlacing stems, which holds fast to the grains. Smaller clumps mimic the larger, and *Sporobolus* succeeds by developing strong roots but soft pliable stems, which, even in the air, lie prostrate, like green tresses combed back by the touch of the last wave, until the next incoming tide washes them to and fro like the softest algae. In surprisingly exposed places the curious little clover-like, purple-flowered *Desmodium* stands bravely in low, compact bunches, while *Kyllinga* with its small white flowers creeps feebly a few inches from its roots. These, with a few isolated plants of sedge, form the outliers of the plant world, in the ever shifting zone between solid land and the impassable barrier of low tide.

The mangroves cheat the jungle and find their light and air far beyond the competition of the great moras and purpleheart, where, although thriving a few yards away, these mighty trees cannot follow. Like most get-rich-quick schemes, however, the mangroves yield to the law of compensation, and every branch, twig and root has its parasites and epiphytes. Bromeliads, in serried rows and clusters, are so abundant that they sometimes break down their very support. The roots above low water are coated with moss and lichens, while the branches are often put under terrific strain by burdens of heavy vines, such as *Souroubea guianensis* Aubl., and its interesting relations, several species of *Marcgravia.* Even the topmost twigs are not free from invasion. While the mangroves' own flowers are small and inconspicuous, the epiphytic orchids are numerous and beautiful, and when they are in full flower their odor and color make it a delight to canoe through the arching roots. The most abundant forms are *Epidendrum fragrans* Sw., *Epidendrum nocturnum* Jacq., and *Diacrium bicornutum* (Hooker) Benth.

While the actual flora of the tidal area is limited and fixed, yet this zone offers one of the most fertile fields for another phase of botany,—the flotsam and jetsam of the river current. Every receding tide leaves a host of stranded nuts and seeds. As I once wrote of this same current farther down stream, "There were spheres and kidney-shapes, half-circles and crescents, heads of little old men and pods like scimitars and others like boomerangs. Some were dull, others polished and varnished. They were red and green, brown and pink and mauve and a few gorgeous ones shaded from salmon into the most brilliant orange and yellow. Most

were as lifeless in appearance as empty shells but there were many with the tiny root and natal leaves sprouting hopefully through a chink."[2] And so along the line of the highest tides scores of small plants are often found sprouting, which have drifted down many miles from hinterland jungles.

Jungle

Unless artificially altered by man, the littoral flora merges directly and abruptly with that of the jungle. The outermost trees may be a mangrove with strong buttressed trunk, and little to indicate its spidery, amphibious character farther riverward. Close alongside is a tall jungle tree, perhaps a mora, which reaches up a hundred and fifty feet, or a purple-heart almost as tall.

At Kartabo some of the river jungle is swampy, with palms as a dominant association, mingled with hard and soft wood trees. Passing to dry or higher ground, we find the typical rain forest of Eastern South America. It is impossible to describe in accurate detail, for every square yard, every dense thicket or open glade has a character of its own. In the most luxuriant primeval jungle, the great trees rise at considerable distances from each other, with trunks straight as plummets, and often quite bare of branches for one hundred feet. They support such a dense canopy of their own and of parasitic foliage that there is always a dimness as of twilight beneath. The undergrowth is scanty and low, and the midjungle is broken only by occasional lianas or aerial rootlets, all of which are as straight as the tree-trunks.

Where plantations of the Dutch once existed in the far distant past, or more recent clearings made by the Indians for cassava, the new growth never quite regains its maximum development. In these changed conditions, while there are very many large, very tall trees, yet there is not the unbroken aspect of the roof of the jungle, and the undergrowth instantly reflects this in its more lush character, both in abundance of aspiring saplings and in lesser ferns and shrubs. Jungle of these and of intermediate types is found in the research area.

In swampy areas *Ichnosiphon* grows luxuriantly, tall, smooth, reed-like green stems, with a burst of leaves at the summit. Ant-birds sometimes build in the heart of the foliage head, and the split

[2] Jungle Peace, p. 75

Fig 4. Palm swamp near the Research Station.
Photograph by John Tee-Van.

stems are used by the Indians in basket making. Comacuballi lianas climb trees and palms and thrust out masses of red berries beloved of birds. In these places wild ginger, escaped from long forgotten plantations, sends its six to twelve foot leaves up from compact clumps, and *Heliconias* run riot.

Even in low jungle one can always see through the undergrowth for ten to thirty yards, and while interlacing vines sometimes make going difficult, usually it is only fallen trees and branches which hinder one. Thorns are rare, but when they do occur, as on the climbing palms, it is useless to force one's way. They must be patiently pushed aside or cut away. The jungle floor is never bare. One may tramp for hours and never know whether sand or black mold is the substratum underfoot. There is always a thick mat of fallen leaves and twigs, sometimes an inch or two, sometimes a foot deep. Digging down we find these gradually altering from the leaf which has just eddied down, through blackened, half decayed leaves to homogeneous, earthen mold, ready to be drawn up again into living sap. In the dry season the leaves crackle at every step, in the wet they are silent to the foot, and soaked, but always they are present. No thick growth of moss lies underfoot but every inch of twig and branch and trunk is painted and hung with fungi, lichens and moss.

In deep jungle, flowers, up to man height, are not uncommon, but inconspicuous, but fallen petals and blooms are abundant, often having dropped a hundred feet from some obscure vine, not distinguishable from the foliage at that height. Or zones of intense sweetness will indicate flowers which are invisible. If looked for, dozens of inconspicuous greenish blooms will be found low down or springing from the mold, but at the least hint of glade or open trail, color becomes evident, and the sombre jungle loses its meaning.

Color in masses is to be found in the tree-tops when whole trees burst into a solid head of lavender or pink within twenty-four hours, or along the river banks, where hanging vines transform overnight into floral avalanches. Another source of color peculiar to the tropics is the brilliance of new leaves. A Kartabo spring reminds one of the northern woods at the height of autumnal change. This leaf coloring holds even in the dark jungle shade, and here too the pigmented place of flowers is taken by the leaves of caladiums, of *Tontanea* and of *Coccocypselum*, on whose chlorophyll palettes are spread splashes and lines of white, cream, pink and scarlet.

Lichens, fungi and mosses are everywhere. Even in the dry season, they flourish in damp places, while during the rains they rival the flowers of the glades in color, and are of every conceivable form and shape, mimicking on a small scale all the greater growths of shrubs, trees, vines, besides adding such similes as umbrellas, lace-work, and pagodas. As for molds, smuts and rusts on the leaves of jungle growths, a mycologist who spent four days at the Research Station collected three hundred forms in a few trips along the trails.

The importance of this density of vegetable growth covering every inch of dry land, cannot be appraised too highly, no matter what form of organic life we choose for intensive study. It actually brings into existence a new land of organic life,—secondary, pseudo meadows and aerial fields, a hundred feet or more above the solid ground, transferring to these hanging gardens the color and variety of foliage, flower and fruit, as well as specialized animal life of every group, which for our lowly structure and limited senses exists elsewhere only in open clearings.

Jungle Trees from Sixty to One Hundred and Fifty Feet, Rarely Two Hundred Feet in Height, Found in the Research Area

Dimorphandra excelsa (Schomb.) Baill.
Mora: One of the tallest of jungle trees, often with enormous buttresses; common close to tide or in swampy places.

Nectandra rodiei Schomb.
Greenheart: Another giant of the tropical rain forest, the most sought for commercial wood; much heavier than water.

Carapa guianensis Aubl.
Crabwood, Guiana Mahogany: Very tall trees, second in value commercially only to greenheart. It is the cheapest Colony timber. Crab-oil is made from the kernel of the fruit.

Pentaclethra macroloba (Willd.) Kuntze.
Trysil: Medium to large timber trees, usually near water; very finely divided foliage, long tasseled flower panicles attracting hosts of insects. In full flower throughout May.

Aspidospermum excelsum Benth.
Paddlewood, Yaruru: Several large trees in the area; stumps of

others show where the Indians have obtained paddles in past years.

Rhizophora mangle Linné.
Mangrove: Forms a pure culture littoral fringe in many places.

Spachea elegans A. Juss.
Pigeon-berry: A tree of medium height thriving both in jungle and clearing, covered in April with a dense mass of panicled blossoms, attracting hosts of insects and birds. A decoction of the bark is an astringent, used by the Indians for dressing cuts.

Inga sp.
Waikey: One of the few soft-wood trees; medium to large, smooth, whitish bark, moderate pointed leaves.

Hevea sp.
Hatteeballi: A tall tree of deep jungle.

Sapium jenmani Hemsl.
Wild Rubber: Grows to very large size; does not die when exposed to direct sunlight by the cutting of surrounding jungle; smooth-barked; the tallest trees develop thick buttresses.

Vochysia tetraphylla DC.
Etaballi: Tall jungle tree, with large bole, slightly roughened or scaly bark, rich, dark green foliage, golden brown wood with silver grain, bursts suddenly into bloom about April 1st, the flowering lasting throughout the month. A second season of less luxuriant blossoming begins August 15th.

Cassia multijuga Rich.
Guana: Tall white-barked tree, finely divided foliage, conspicuous yellow flowers, abundant along river banks and near clearings; very abundant. Height of flowering September 1st to 15th. Exceedingly attractive to insects.

Anacardium rhinocarpus DC.
Wild Cashew, Hoomalgee, Hubudi: Tall tree of deep jungle.

Spondias lutea Linné.
Wild Plum, Hog Plum, Hooboobaili: Tall jungle tree, thriving also in clearings. The yellow, oblong, delicious smelling fruit is eaten by birds, animals, and Indians; bark rough with longitudinal lines, pinnated leaves. Most individuals begin to drop fruit in late February, and continue steadily for four months, the last falling in July.

Other trees, perhaps close by, but fewer in number, begin their season of ripened fruit August 15th and end in November.

Copaifera pubiflora Benth.
Purpleheart: Uncommon, very large jungle tree; one of the tallest in the research area recently fell into the waters of the Mazaruni. It showed three hundred and eighty annular rings. The heart is deep purple or magenta, and is extremely hard; logs free from sapwood are sometimes a yard square.

Piratinera guianensis Aubl.
Letterwood, Snakewood: Chocolate wood with patches of brown and black, like the skin of some snakes; used for canes and small ornamental objects, and by the Indians for bows, although very brittle. The trees are small, full-grown ones being only sixty feet high; once abundant, as indicated by old Dutch reports of cargoes exchanged with the Indians for this wood; now a few small saplings only are left in this locality.

Hymenaea combaril Linné.
Locust, Siniri: Tall, with smooth bark, beautifully banded with red, gray and yellowish, like layers of clay; very finely divided foliage. The wood is orange-red. The Indians make wood-skin canoes from the bark.

Hieronyma laxiflora Muell. Arg.
Suradanni: Deep red wood, cross-grained, good for gun-stocks and canoes. One of the largest trees of the research area jungle is of this species.

Simarupa amara or *officinalis*.
Simarupa, Matchwood Tree: Wood milk-white, soft; one of the tallest trees, projecting high above the surrounding jungle. The only jungle tree we have been able to scale, reaching a height of eighty feet by means of two alternating rows of large spikes driven deep in. The second year a newly established nest of stinging bees made it impossible to climb. Deeply lined bark, well covered with moss and lichens, very finely pinnated foliage; used for boards and match sticks.

Unidentified.
Dalina: A tall forest tree with exceedingly hard wood. Trunk deeply grooved, often looking like a mass of lianas; leaves large and oval.

Cecropia palmata.
Cecropia, Congo Pump, Pumpwood, Wanasuru: Very tall and rapidly growing tree in jungle, also springing up in abandoned cassava fields. Wood light, used for floats. In tall jungle individuals, the base is supported by mangrove-like flying buttresses. Enormous leaves in a complex cyme, rattling together loudly in the slightest breeze. The sole food of three-toed sloths.

Unidentified.
Kurahara: Although producing logs fifty feet long by twenty inches square, and excellent for making furniture, canoes and spars, yet this tall tree is unidentified. The wood is reddish brown and takes a fine polish. In K 14 is a young tree with straight, bare stem and a rounded canopy of leaves, umbrella-like. The leaves form a large palmated cluster on the end of a very long, straight, horizontal stalk, arising directly from the trunk.

Unidentified.
Meerah-wood, Antwood: A very large tree, getting its name from harboring a species of stinging ant.

Unidentified.
Hooroowassa: A very large jungle tree, small, short-oval, pinnated leaves, and with small curved bean holding about ten seeds; bark light colored, flaking off in scales, as soft as pine. An enormous one in N 11, supporting masses of very large epiphytes.

Myristica surinamensis Roland.
Dalli: Very rapid growing, soft wood; rare, only one or two trees near laboratory. Trunk tall and straight, whitish, coarse pinnated foliage.

Unidentified.
Wareemeah: Common tall jungle tree. On one, which was cut close to the laboratory, ninety-three species of ants were found by Professor William M. Wheeler. Sprouts come up very quickly from the stump.

Nectandra sp.
Silverballi: Bark silvery white, branches wide spreading in young tree.

Unidentified.
Potchuwee: Tall tree, uncommon.

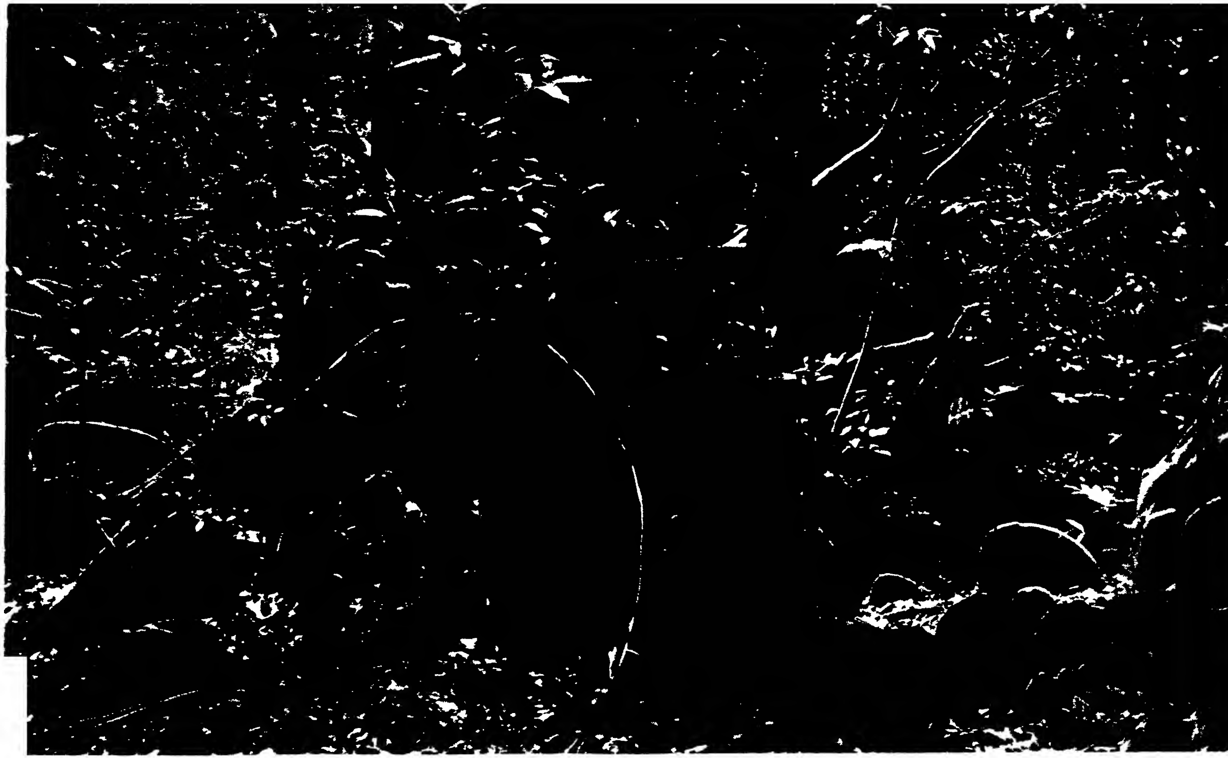

Fig 5. A Mora swamp, where great exposed roots writhe and twist in fantastic shapes.
Photograph by Thomas Smolucha.

Tapirira guianensis Aubl.
Duka: Occasionally found in the jungle, eighteen inches through; the bark is reddish, not light, and the trunk marred with old branch stubs. Very rapid grower in new clearings. Has edible, purple, grape-like fruit.

Unidentified.
Arrancanduck: Moderately tall tree, large coarse leaves.

Psidium guava.
Cockreeou, Wild Guava: Medium tree, olive gray bark, smooth as if oiled. Many stems shoot up from old stumps; large broad leaves. Introduced from high lands.

Humirium floribundam Mart.
Tauroneero: Large tree, often with a few dead upper branches on which birds love to perch. Abundant. Fruit is edible, wood dark reddish, extremely hard.

Tenipa americana Linné.
Makreekoonee: Fairly tall jungle tree, variegated, slightly roughened bark, medium sized leaves. Bark makes a black dye.

Jungle Palms

Astrocaryum tucuma Mart.
Cuyuru Palm, Acqueero: Thorny-stemmed, a tall sentinel in front of laboratory: fruit eaten by Indian children and by animals.

Maximilliana regia Mart.
Kokorite Palm: Grows very tall; small, recently sprouted ones are common.

Cocos nucifera L.
Cocoanut Palm: A single one, full grown, in D 6.

Mauritia flexuosa L. f.
Eta Palm: Enormous stemmed and leaved, with equally large curtains of blossom and fruit. A very large one at edge of tide in G 3. The young, unopened leaves furnish the well-known tibireri twine, of which "grass" hammocks are made; the dry, pithy stems of the petioles make excellent razor strops.

Euterpe edulis Mart.
Manicole Palm: Characterized by huge palm-leaf fan fronds.

Fig 6 The jungle laboratory at Kartabo, beneath giant bamboos planted 300 years ago by the Dutch
Photograph by Paul G Howes

Clearing

Immediately about Kartabo laboratory are twenty-five clumps of bamboo, covering a compound of three acres. These are a very tall Javan species, imported and planted by the Dutch two hundred and fifty or three hundred years ago. They are ideal for bungalow trees, as they provide abundant shade, yet let the air pass freely; they are almost immune from insect attack, and their dense carpet of leaves forms a clean dry footing and prevents the growth of weeds. They respond to the least care, and when a clump is cleared out, the young shoots appear and grow with astonishing rapidity. A new sprout two feet high may in a very short time tower far above one's head. We made two estimates of growth, during the early part of the rainy season, and found that vigorous young shoots grew from eight to twelve inches a day. One of these increased in height from three and a half to sixteen feet in sixteen days. Parasites are unable to gain a foothold on the clean, hard, siliceous stems, and even the leaf-cutting ants have no use for the leaves.

West of the laboratory is a clearing of seven acres which four years ago was in coarse grass. Even after this time it could still be called a clearing, but another full year reduced it to a glade, with tall saplings sprouting in all directions, and the jungle creeping in from all sides. This change is a most interesting one, and the alteration from jungle affords opportunity for hosts of strange organisms, floral and faunal. Throughout the area covered by most of the research work at Kartabo Point, two thousand by four thousand feet, as well as further inland, numerous trails have been cut, which afford easy access to the lateral areas of jungle. To the south of the laboratory a field is cleared and under cassava, bordered by tall jungle trees, and this again exhibits entirely different associations rich in new conditions of floral relationship.

In the clearing, every patch of open ground is carpeted with a dense growth of the cheerful little pink Mazaruni primroses, *Sipanea pratensis* Aubl.,—by far the dominant color note of the open and with many tiny weevils and other insect hosts. With them are numerous other small flowering plants, such as *Spermacoce verticillata* Linné and *caerulescens* Aubl., and such curious little growths as the Christmas-tree plant, *Dupatya*. The waist-deep, meadow-like parts show dense growths of Vervain, *Stachytarpheta cayennensis* Vahl, and Velvet Leaf, *Sida cordifolia* Linné, together with clumps

Fig 7 The row of tents at the edge of the jungle that serve as sleeping quarters for the Staff
Photograph by Paul G Howes

of plume-grass and scores of unnamed growths. Scattered here and there are taller patches of Orinoco boneset, *Mikania orinocensis* H.B.K., some of which burst suddenly into flower at the end of December, while others blossom from March to May. It harbors many interesting Hemiptera,—coccids and membracids. Sprouting plants of Cashew, *Anacardium occidentale*, are common. The fleshy, pear-shaped receptacle of the fruit is an edible astringent, greatly beloved of tanagers and other birds, and the kernel of the kidney-shaped fruit at the end of the receptacle, when roasted, is an article of commerce. The intermediate layer of fruit contains as acrid caustic oil.

In unexpected places great clumps of strange lilies, *Cruium*, spring up, their beautiful white petals filling the whole compound with their fragrance, and isolated plants of scarlet tiger lilies tear colorful gaps in the mass of clearing green. The pinwheel flower, *Tabernaemontana undulata* Vahl., shows one of the most amazing floral-fruit transformations, its gaping scarlet and black fruit developing from the tiniest whorls of petals. There is also the Tree of Life, *Bryophyllum pinnatum* (Lam.) Kury., as much at home as I have seen it in Ceylon and a score of other places. Sensitive plants, *Mimosa polydactyla* H. & B., wilt at a touch and scattered about are stray bushes of Indigo, *Indigofera* sp.,—heirlooms of thrifty Dutch settlers, which have handed down their seeds for perhaps three hundred years. Vines wind in and out, simulating the lianas of the nearby jungle, unnoticed until revealed by a sudden burst of blossoms, as the aliamandas and convolvulus.

A still larger growth may be defined as saplings, of which the Duka, *Tapirira guianensis* Aubl., is the most rapid grower. At present there are scattered through the western part of the clearing, dozens of their light-colored, lichen-marbled trunks, with oval, pinnated leaves. With these, young jungle trees, such as Wareemeah, are sprouting from stumps of the old forest. There are also a few lime trees, *Citrus medica acida*, planted many years ago, and smothered in low growths, but still bearing abundantly. Guavas, *Psidium*, also grow here and there, and attract birds and wasps and even small mammals which feast on their fruit.

Here and in many other places, both clearing and jungle, *Melastomas* grow rank, some as trees, others as shrubs, bushes, or even crawling, vine-like, over open sandy places. One form, called Messopra by the Bovianders, *Bellucia grossularioides* Triana, is common

about the bungalow, with great, coarse rough leaves, woody, scaly stems and rounded white blossoms, all a haven for a whole fauna of insect life, while the whitish berries are delicious eating.

The Clearing Trail, which is merely the beginning of the seventy-two mile Puruni Trail, where it leads westward through the clearing is perhaps the most interesting place near the laboratory. It lies along the seam, the very point of meeting of jungle and clearing, and a single yard to left or right often marks an entirely distinct flora and fauna.

The jungle edge hides its bareness with a dense growth of shrubs and half trees, often flowering profusely and attracting hosts of insects and birds. Among these is torchwood, or Haiawa, *Icica heptaphyllum* Aubl., with its dense foliage, whose wood, when pounded and teased out, is used by the Indians for candles, Blood-leaf, *Vismia ferruginea* H.B.K., and *guianensis* Pers., with great leathery leaves, beloved by a multitude of insects, Trysil Trees, with the finest of pinnated foliage, Arrancanduck, and Cassia, whose great golden panicles are Mecca to all lovers of nectar, whether scaly or feathered, with six legs or two. Here too we find tree Cashews, Clusia, Wild Cocoa and Messopra, with small flowers, and Maibike with its stems lined with lavender bloom. Here grow the exquisite Shooting Star blossoms, *Posequeria latifolia* R. & S., whose ultimate seeds look like rounded pebbles of translucent quartz.

Along shore, the edge of the jungle is varied by many smaller trees and vines, some of which are characterized by great solid masses of bloom at certain seasons.

Here grows the wild cocoa, *Pachira aquatica* Aubl., flowering twice a year, each blossom a foot across, a plume-like mass of lilac-colored stamens, followed later by the great leather colored pods, the resemblance of which to cocoa pods gives the common name. The close-packed seeds are delicious, either raw or roasted. Cassia is common here, and *Posequeria*, but vines have the best chance and a single plant may sometimes ramify for several hundred feet along the wall of jungle foliage, climbing to the very top. Especially noticeable are Allamandas, Bignonias, Petrea, and *Souroubea guianensis* Aubl., the last with its glossy leaves and panicles of stiff, scarlet flowers, whose fragrance is delicate and very penetrating. When a tree is entirely covered with this vine in full flower, it is a source of constant attraction to honey-creepers, hummingbirds and hosts of bees. Its near relative, *Marcgravia*, vies with it in abundance along

the shore and sometimes presents a solid front, quite obscuring the foliage of its supporting host behind. Its umbels of curious nectaries surmounted by the drooping circle of flowers are still a mystery as to their exact method of fertilization, whether by hawkmoth, hummingbird, or otherwise.

Another shore plant, which in certain positions becomes almost a vine, is the caterpillar flower, *Combretum laxum* Loefl., with its brilliant yellow and scarlet blossoms, which day by day unfold more of their furry lengths.

The Maibike, as the Akawais call it, or Aliku, Benda, or Waikee, as the Boylanders name it, *Pithecolobium latifolium* Benth., forms bushes or moderate sized trees growing along shore, flowering in mid-July—a mass of rose colored bloom, solidly lining the branches. Bees, butterflies and many other insects come to it in swarms.

Spider lilies, *Hymenocallis*, hold up their drooping, streaming petals from among the sedges and reeds, while in swampy areas grow great clumps of ginger lilies, *Hedychium coronarium* Konig; in dry clearing edges appear, in the early rains, single plants of scarlet tiger lilies, *Hippeastrum*.

Although the jungle growth is so luxuriant, yet the soil is very thin, a mere skim of black mold from six inches to two feet lying on the sand or clay. An Indian's cassava field planted in fresh-cleared jungle soil will so deplete the ground that a second crop is never attempted, but the Indian allows the jungle to cover the clearing, while he cuts a new one.

In this immediate vicinity, on the opposite side of the river at Kalacoon, three exhaustive attempts have been made to raise crops on a large commercial scale, first sisal hemp, then rubber, and finally cassava. All have failed, the first because the humidity was too great to dry the fibre satisfactorily, the second because of lack of vertical root space and a devastating leaf disease, and the third because of general expense of labor and constant fertilization. Nature hereabouts gives freely of its riches of gold and diamonds, man may tap the wild rubber trees of the jungle or with effort carry off a few mighty boles to be sawn into lumber, but as yet she suffers no permanent replacement of her primeval jungle with plants of man's domesticating.

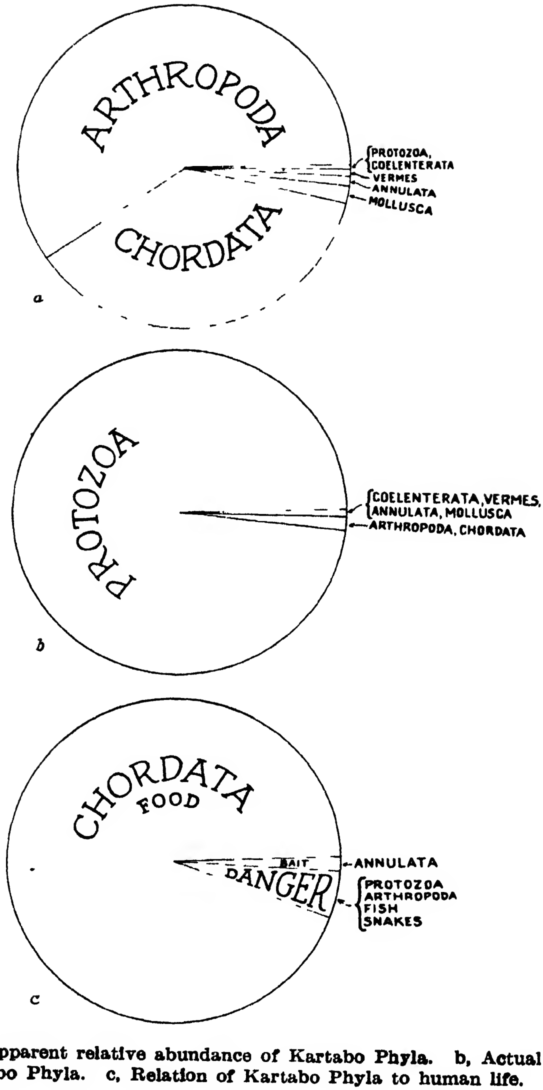

Fig. 8.—a, Apparent relative abundance of Kartabo Phyla. b, Actual relative abundance of Kartabo Phyla. c, Relation of Kartabo Phyla to human life.

VI—The Fauna of Kartabo

Foreword

My treatment, in the present paper, of the fauna of the quarter of a square mile at Kartabo is of the most general character, intended as a preliminary skeleton framework for the more detailed ecological papers and monographs to follow. In addition it will serve to answer some of the numerous inquiries which I receive, relating to the presence or relative abundance of some family or other of organisms. In the case of the vertebrates I have included more detailed accounts of the interrelations in regard to food.

Taking into consideration the fact that most of the groups of organisms have not yet been worked up, nor the innumerable new species been named, I have thought it best, in treating of them, to make use of the simplest, most conservative of classifications.

As almost no two writers use our English terms of occurrence with the same meanings or relative values, I submit my own interpretation of the five relative terms:

Terms of Occurrence

Abundant—To be seen every day and on every walk.
Common—To be found whenever searched for.
Occasional—Uncommon.
Rare—Observed but seldom.
Unique—Recorded but once from the Research Area.
Probable—Present in numbers just outside the Research Area.

Phyla of the Animal Kingdom Found at Kartabo

I—Protozoa	VII—Molluscoida
II—Porifera	VIII—(Echinodermata)
III—Coelenterata	IX—Annulata
IV—Platyhelminthes	X—Mollusca
V—Nematelminthes	XI—Arthropoda
VI—Trochelminthes	XII—Chordata

Admitting these twelve Phyla in the Animal Kingdom, eleven are found within the zone of research at Kartabo. The missing one is Echinodermata, and while we are many miles from salt water, it was rather interesting and amusing to come across remains of sea urchins and starfish near the shore a few yards from

the laboratory. Unfortunately for our summary of living forms, however, these specimens of Echinoderms were in blocks of coral brought as ballast two or three centuries ago by Dutch sailing ships from some distant salt-water port. Here they were dumped overboard to make room for cargoes of sugar and letter-wood.

On this tiny portion of the earth's surface, this quarter of a mile of jungle and water, the animal life is quite undisturbed by man, and just as it has evolved through the ages. To unaided human vision, backed by enthusiastic interest, two phyla occupy about nineteen-twentieths of the entire animal life. With criteria of size and visibility we must represent the Kartabo fauna as in the adjoining Fig. 8, *a*. With actual number of individuals as guide the animal life would be rearranged as in *b*. Again, when the fauna is considered in its relation to the life of the native Indian, or in the case of our own physical life, it assumes a very different phase, illustrated in *c*.

One Hour of Jungle Life

The dearth of life and the silence in the tropical jungle is emphasized and reiterated in book after book of travel, and as long as the observer is actually travelling, he will indeed see little more than the few frightened creatures which rush from his path. When he is content quite to cease being a traveller, and become a stander, or sitter or squatter, the wealth of tropical life begins to be apparent. Even the patient digger or grubber will reap a rich harvest, as when once I searched and found a thousand living beings in a square yard of jungle floor.

Movement, not conspicuous clothing or human form, is the disturbing factor which drives a host of creatures into hiding just before the eyes can detect them, and makes a walk through a primeval forest often a disappointing experience. This can be mitigated by slow movements and intensive observation, and the following is the record of a walk within the research area, west from the Tropical Research Station at Kartabo, back along the Puruni Trail, from 7:30 to 8:30, on the morning of March 26, 1922. There was no wind; the first fifteen minutes were cloudy, while the sun shone brightly the remainder of the time.

I went slowly, making notes as I walked, for forty-five minutes. The last quarter of an hour I spent motionless in one spot near a deep

gully. Writing as rapidly as possible, with only an occasional glance at my note-book, I recorded every hint of living organism seen or heard, five hundred and thirty-six in all, and made a brief written or mental note about each observation. To this list I have added an occasional identification term to clarify my brief written word. It forms, I think, a satisfactory answer to statements of the paucity of jungle life.

Organisms Observed in Forty-five Minutes Along a Tropical Jungle Trail

Brain-fever Cotinga (*Attila*); heard the note of this beautiful bird as I left the Laboratory clearing at 7:30 A.M.
Kiskadee Tyrant Flycatcher (*Pitangus*) seen and heard.
Chestnut-breasted Seedeater (*Sporophila*) in full song.
Spine-tailed Swifts (*Chaetura*), three flying over.
Small Red Beetle.
Giant Black Orioles (*Ostinops*) three seen and heard, one giving courtship performance.
Cicada, heard south.
Dusky Nighthawk (*Caprimulgus*) flying up from trail; a true jungle bird, often perching on high limbs of trees.
Red-backed Caciques (*Cacicus*), two flying toward their nesting trees up the Mazaruni.
Green Trogon (*Trogon strigilatus*) heard giving its breeding song.
Black Cuckoo (*Crotophaga*) heard, whaleep! whaleep!
Small Green Caterpillar.
Green, Long-legged Fly (*Dolichopodidae*) walking swiftly about on leaf.
Small, Black Ichneumon-Fly searching for spiders.
Green Tree Snake (*Oxybelis*) moving slowly through branches.
Large, Brown Cricket (*Eneopterides*) chirping with its vibrating wings.
Green Membracids, eight of these attended by ants on a weed stem.
Small Brown Ants, three running on ground.
Green Dwarf Woodpecker (*Picumnus undulatus*) hammering at an insect's cocoon in a rolled-up leaf.
Small Brown Robber Fly (*Asilidae*) eating prey on leaf.
Blackish Birds, two, unidentified, flying through jungle.
Silver-beaked Tanagers (*Ramphocelus*) two in tree tops.
Yellow-lined Grasshopper, a clearing species, rather out of place in the forest.
Wax-covered Coccids, a group attended by ants.
Large Blue Hunting Wasp (*Pompilid*) half flying, half walking over leaves.
Antbirds (*Formicariidae*), three, unidentified, in dense foliage.
Small Metallic Fly (*Volucella*) on leaf.
Land Crab (*Cardisoma*) scuttling into underbrush.
Metallic Flies, three more.
Giant Green Grasshopper (*Acrididae*) crawling up tree trunk.
Jungle Pigeons (*Leptoptila rufaxilla*), two males calling loudly from neighboring trees.

Organisms observed—continued

Red Ants, four on guard with jaws raised, on leaf.
Small Brown Cricket.
Rufous Hermit Hummingbird (*Phaethornis ruber*) flying across trail.
Small Brown Weevil.
White-spotted Membracids, three in a row along stem.
Caterpillar of black papilio butterfly (*Papilio*).
Cicada calling, different species from other heard seven minutes before.
Guiana Motmots (*Momotus momota*), three perching in berry tree, swinging their tails from side to side.
Small Brown Grasshoppers, two on leaves.
Large Green Katydid on under side of leaf.
Small White-Spotted Beetle (*Chrysomelidae*) on leaf.
Turquoise-Winged Weevil.
Green-and-Black Chalcid Wasp, very small, searching under leaves.
Black-faced Frogs (*Leptodactylus mystacinus*) two in a small pit.
Green Ground Lizard (*Ameiva*), large male in pit.
Cayenne Hermit Hummingbird (*Phaethornis superciliosus*) squeaking among some flowers in a tree-top.
Robber Flies (*Asilidae*) two large, hairy individuals, mating.
Oblique-Striped Jungle Lizard (*Anolis*) scurrying over leaves.
Medium Metallic Bee (*Euglossa*) hovering close to ground.
Carrion Flies, twenty-four, of five species, around dead frog.
Land Minnows (*Rivulus stagnatus*) two of these land-traveling fish in a pit dug for trapping frogs.
Wood Roach (*Blattidae*) small brown roach on dead leaf.
Sulphur-and-White-Breasted Toucan (*Ramphastos vitellinus*), calling to the north.
Small Brown Caterpillars grouped together on leaf.
Woodpecker, unidentified, hammering to the south.
Small Gnats, a large cloud hovering overhead.
Quadrille Bird (*Leucolepis musica*) gave its wonderful call close to the trail three times, wholly different each time. Did not see it.
Green Stick Grasshopper (*Tryxalid*) resting in center of leaf.
Giant Black Solitary Ant (*Dinoponera*) walking up tree.
Rufous Hermit Hummingbird flying about my face.
Yellow-winged Deer Fly (*Tabanidae*) alighting on my hand.
Common Ithomiid Butterfly (*Melinea* ?) fluttering slowly along.
Crackling Manakins (*Manacus manacus*), a pair flying across trail.
Small Army Ants, a file passing rapidly over leaves and ground.
Bird-winged Morpho Butterfly (*Morpho menelaus*) zig-zagging rapidly past me up the trail.
Robber Fly with a small wasp in its jaws.
Hump-backed Flies (*Hylomyzidae*) resting on leaves.
Brown Ant on leaf.
Green Spider under leaf.
Ichneumon-Fly with white antennae flying slowly.
Small White-spotted Caterpillar on leaf.
Giant Solitary Ants, three on stem.

Organisms observed—continued

Large Brown Spider in web.
Ichneumon-Fly with yellow, black-spotted wings.
Giant Lineated Woodpecker (*Coephleus lineatus*) flying over in the direction of the bird which had been hammering.
Red Howling Monkeys (*Alouatta*) heard to the southward.
Jungle Pigeons heard in a new direction.
Green Spider devouring green fly.
Small Brown Ants, six on one leaf.
Large Chestnut Bee (*Xylocopa*) half buried in a yellow allamanda blossom.
Minute Gnat flying close to my eye.
Spot-winged Antcreeper (*Sclateria leucostigma*) two in vine near trail.
Carrion Flies and Ants on bird dropping.
Small Green Caterpillar looping along edge of leaf.
Yellow-headed Vulture (*Cathartes urubitinga*) swooping low, close over the trees.
Brown Coccids, many on a branch, attended by ants.
Small Green Buprestid Beetle.
Red-throated Caracara (*Ibycter americanus*) calling with loud raucous screams upon discovering me.
Cinereous Antbird (*Thamnomanes glaucus*) calling just out of sight in the jungle, also annoyed by my presence.
Quadrille Bird, a second individual appearing for a moment.
Ithomiid Butterflies, two alighting on leaves.
Green Wood Roach (*Panchloridae*) on green leaf.
Brown Silk Cocoon with chrysalid moving about inside.
Spiders, two fighting on small web.
Large Antbird, unidentified, flying swiftly across trail.
Callistes, Chlorophanes and Bright Colored Tanagers, eight in tall trees.
Large Red Ant on ground.
Small Black and White Butterfly (*Erycinid*) under leaf.
Small Black Flies, three waving their wings and whirling about on leaf.
Long-horned Grasshopper mimicking daddy-long-legs (captured).
Black Chalcid Wasp attacking pink caterpillar.
Guiana Wood Nymph Hummingbird (*Thalurania*) following me for some distance.
Short-tailed Swift (*Chaetura*) flying over.
Minute Gnats, three on a small flower.
Azteca Ants around suspended nest.
Metallic Jumping Spider with fly on leaf.
Termites or White Ants making tunnel near their nest on tree.
Black-fronted Antbird (*Myrmoderas ferruginea*) giving its teacher-teacher-teacher call near the trail.
White-headed Tayra (*Tayra barbara*) one of these giant weasels rushing down out of a tree and off through the underbrush with a great riot of noise.
Minute, Red-Spotted Spider hanging from strand of silk.
Hump-backed Flies (*Hylomyzidae*), two on leaf mating.
Mottled Spider on huge web (*Argiope*), with two blossoms, but no living prey entangled.

Organisms observed—continued

Green-winged Macaws (*Ara chloroptera*), calling to the north, and later appearing, flying high overhead.
Brown Loop Worm with front part of body sticking out from stem like a dead twig.
Grey Jumping Spiders (*Attidae*) motionless on plant.
Red Ant on ground.
Hump-backed Fly.
Tiny White Moth flying close to ground.
Large Grey Robber Fly resting on twig.
Large Species Hump-backed Flies, three on one leaf.
Turquoise-backed Weevil under leaf.
Mealy Amazon Parrots (*Amazona farinosa*) two flying from tree with loud screams.
Pygmy Antbird (*Myrmotherula pygmea*) heard.
Woodpecker hammering loudly ahead.
Small Reddish Moth on leaf.
Small Hump-backed Fly on leaf.
Olive-backed Ovenbird (*Automolus infuscatus*), two feeding on small tree.
Woodpeckers, two small ones, too high for identification.
White-breasted Antwren (*Rhamphocaenus albiventris*) one seen and others heard; this one hanging upside down picking at a leaf.
Spot-Winged Antbird seen near trail.
Antbirds, two, unidentified, with the Spot-wing.
Small Parrots, probably *Urochroma*, flying overhead.
Red Howling Monkeys, a second band heard far to the west.
Green Mantis gesticulating on leaf.
Brown Robber Fly with unidentified prey.
Brown, Yellow-lined Grasshopper, a tree-top species, on leaf.
Macaws heard (probably the same birds).
Membracids shaped like small nuts, eight attended by four ants.
Coccids attended by minute black ants.
Membracid with pillar-shaped thorax (collected).
Small Hump-backed Fly.
High-arched Membracid on same plant, attended by ant.
Purple-breasted Cotinga (*Cotinga cotinga*) heard in distance.
Small Inch-Worm on my sleeve.
Small Brown Wood-Roaches, two running along trail.
Crowd of Termites rushing out of their nest accidentally broken open.
Metallic Carrion Fly on leaf.
Lace-winged Fly (*Chrysopidae*) resting under leaf.
Metallic Coppery Scarab Beetle resting on leaf.
Dancing-Wing Flies (*Trypetidae*), gyrating on a leaf.
Dumb-Bell-Shaped, Long-Legged Flies flying and on leaf, one elaborately courting the other.
Small Metallic Green Fly (*Volucella*) on flower.
Maggots (*Diptera*) thirty or more around a bit of carrion.
Small Black and White Butterflies (Pierids, although an exact copy of *Heliconids* —genus *Dismorphia*).

Organisms observed—continued

Small Brown Dragonfly on tip of leaf.
Small Birds, two in tree, not identified.
Yellow-bellied Calliste Tanagers (*Tangara mexicana*) three in tree.
Large Hump-backed Fly.
Yellow-winged Deer Fly buzzing about my face.
Green Spider on green leaf.
Small Metallic Fly.
Small Brown Grasshopper.
Hairy Black Robber Fly.
Termites, small colony of these with snapping jaws.
Muscid Fly on leaf.
Dark Saddle Membracids with four ant attendants.
Golden Metallic Bee.
Four Black Trigonid Bees.
Two Ithomiid Butterflies.
White Flower-like Spider
Two Volucella Flies.
Slender Black Ant.
Dolichopodid Fly.
Sulphur- and-White-breasted Toucans, a pair calling.
Guiana Motmots calling in their muffled tones ahead.
Small Copper Beetle dropping to the earth at a touch.
Minute White Moth.
Brown, Long-legged Ctenid Spider.
White-antennaed Braconid Wasp.
Small Brown Ants, three carrying a bit of food.
White-crowned Manakin (*Pipra leucocilla*), a male flew past
Yellow and Black Cercopid Bug (*Tomaspis ruber*).
Minute Metallic Fly.
Brown and Red Caterpillar.
Red-rimmed Black Hemipteron on leaf.
Giant Blue, Tarantula-Killing Wasp.
Three White-crowned Manakins, two males and a female.
Dusky Parrots (*Pionus fuscus*), three calling from tree overhead.
Woodpeckers hammering, one west, a second south.
White-throated Thrush (*Turdus phaeopygus*), parent and nestling hardly able to fly, pursued them but could not capture the young one.
Large Rhinoceros Beetle flying past.
Macaws heard, perhaps the same pair seen earlier.
Black-throated Trogon (*Trogonurus curucui*) heard and seen.
Yellow-throated Caracara (*Ibycter ater*), flying out of low tree screaming loudly.
Yellow-headed Vultures, two soaring past.
Small Swift, unidentified.
Small Gold-fronted Hummingbird, unidentified.
Large Jungle Damsel-Fly (*Mecistogaster*) fluttering slowly over the trail.
Small Hump-backed Flies, two on leaves.
Metallic Jumping Spider with small insect.

Organisms observed—continued

Saddle Membracids, eight adults and young, attended by three ants.
Furry Black Caterpillar eating leaf.
Small Robber Flies, two mating.
Tiny Red Caterpillar under rolled leaf.
Walking Stick Insect (*Phasmid*) hanging by four legs from a leaf, the front pair stretched out along the antennae.
Agouti (*Dasyprocta aguti flavescens*) rushing away from a wild plum tree, grunting loudly.
Small White Pierid Butterfly on flower.
Red Howling Monkeys heard, probably the same as the last band.
Cloud of Gnats in mid air.
White-fronted Antbirds (*Pithys albifrons*) three chirping close to trail, all seen.
Antbird, another species seen only for a moment.
Army Ants (*Eciton burchelli*), a small fan of these ants, accounting for the presence of the antbirds.
Three Wood-Roaches scurried out from among dead leaves.
Two Daddy-Long-Legs hiding among the same leaves.
Large Brown Millipede (*Polydesmid*) crawling on ground.
Small Flies, six hovering over a dead spider.
Two More Wood Roaches.
Harlequin Jungle Cricket (*Rhipipteryx*) flew ahead of me.
White-fronted Antbird, a fourth individual.
Wedge-billed Woodhewer (*Glyphorhynchus cuneatus*) creeping up trunk of tree.
Yellow Chalcid Wasp resting on leaf.
Antbirds, flock of about a dozen in tall tree, unidentified.
Ameiva Lizard, rushing into hole as I approached.
Long-legged Dolichopodid Fly on leaf.
Giant Metallic Blue Bee flying past.
Tryxalid Grasshopper motionless on leaf.
Azteca Ants in nest suspended over trail.

Reached Gully at 8:15 and Observed the Following Organisms within Fifteen Minutes:

Red-fronted Woodpecker (*Tripsurus rubrifrons*) seen and heard hammering almost overhead.
Olive-backed Ovenbird (*Automolus*) seen picking up food from bottom of gully.
Amazon Parrots calling, not seen.
Mouse-Colored Bushbird (*Hypolophus murinus*) calling.
Small Ichneumon-Fly alighting on my hand.
Two Muscid Flies hovering over flower.
Minute Grey Moth flying nearby.
Brown Cricket calling a few feet away.
Palm Tanagers (*Thraupis palmarum*) heard and seen in tree.
Guiana Squirrel (*Guerlinguetus aestuans*) scolding me a minute or more from the center of a bush across the gully.

Organisms observed—continued

Red Howling Monkeys making a great uproar to the north, probably a new band.
Two Small Flies in mid air.
Minute Gnat flying about my eyes.
Macaws again, probably the same pair.
Reddish Robber Fly resting on leaf.
Ring-tailed Monkeys (*Cebus apella apella*) swinging by within fifty feet, passing close to the ground.
Large Ant with the tip of the abdomen jet black.
Trypetid Dancing-wing Fly.
Long-tailed Hummingbird, probably *Phaethornis*, flying swiftly.
Minute Yellow Ants, twenty in small flower.
Deer Fly buzzing close to my face.
Small Yellow Caterpillar under nearest leaf.
Small Ithomiid Butterfly flying slowly past.
Variegated Tinamou (*Crypturus variegatus*) calling to the south.
Papilio Butterfly alighting nearby and walking over leaf.

8·30 A M

Summary of Organisms Observed

Within an hour's time I made two hundred and forty-six observations and recorded five hundred and thirty-six living creatures. This included all five phyla of vertebrates, of which one hundred and twenty-eight individuals were birds. The details of this summary are as follows:

	Observations	Individuals
Mammals	8	12
Birds .	71	128
Reptiles	4	4
Amphibians	1	2
Fishes	1	2
Insects:		
Lepidoptera, Imagos .	13	16
Lepidoptera, Caterpillars	11	11
Hymenoptera	39	95+
Diptera. . .	47	139+
Orthoptera	20	25
Hemiptera	13	43
Coleoptera	9	9
Odonata.	2	2
Isoptera .	3	30+
Spiders	11	13
Phalangida	1	3
Millipedes	1	1
Crabs. . . .	1	1
	246	536

PHYLUM I—PROTOZOA

To write of the single-celled animals of a locality is like considering the snow crystals of Greenland or the sand grains of Kartabo beach. My Indians know nothing of their existence, yet they help to make his benab livable, they compel him to cook his game almost at once, and in the end they usually kill him.

Even we who in the past have studied them and watched their successive generations, who can give names to some, and predict their haunts and reactions, almost never think of them until an injury becomes infected, or until the clear water of an aquarium changes to opacity in a few days. Unarmed with a microscope we would admit Protozoa to but small part in the fauna.

In an aquarium on my table one day were several armored catfish, and a floating leaf of a tropical water weed. Within a week the water became green and opaque, but without slime or odor. I found that it was almost a pure culture of the green flagellate *Chlamydomonas*, with a scattering of *Vorticella*. I estimated the number of large drops in the six thousand cubic centimetres of the aquarium at one hundred and twenty thousand. A greatly underestimated count of these green-shelled flagellates gives one hundred thousand to a drop of water, spread over a cover-glass. Another calculation, and I look at the aquarium with awe, for at the lowest estimate it contains twelve billion *Chlamydomonas*—all active, kicking themselves about with their several flagella, busily dividing into more billions and incidentally furnishing the five large catfish with the wherewithal, apparently both oxygen and nourishment, for three months of undisturbed existence in this aquarium.

Observations on Protozoa have all been incidental to other work, but some general facts have been recorded. Of the three habitats. river plankton, swamp-mud and water, and the water in bromeliads, the last has proved to be by far the richest in microscopical life of all kinds.

Four Classes of Protozoa are recognized:

Class I—Sarcodina	Class III—Sporozoa
Class II—Mastigophora	Class IV—Infusoria

All of these are represented in the Kartabo fauna.

Class I—SARCODINA

Amoebae of several species and *Arcella*, the latter occasionally

in great numbers, abound in mangrove bromeliads; *Difflugia* has been found both on debris in Mazaruni current-moved plankton, and in deep swamp pools; *Actinophrys*, or a closely related form, occurs in plankton.

Class II—MASTIGOPHORA

Euglena, *Ceratium* and *Volvox* in bromeliads; *Chlamydomonas* and many other forms of this Class both in bromeliad and swamp water. *Gonium* is one of the most interesting of this group, the few cells clinging together with just sufficient definition of arrangement and division of labor, to adumbrate Metazoa.

Class III—SPOROZOA

Plasmodium is occasionally brought in the blood from Georgetown and other parts of the coast, but there is no indigenous malaria at Kartabo, owing to the complete absence of mosquito carriers.

Class IV—INFUSORIA

Paramoecium is common in bromeliads; *Stentor* has been dredged in Mazaruni mud, and found growing on the eggs of the small, surface-swimming minnow *Tomeurus; Vorticella* occurs commonly in infusions, in mid-river plankton, on fresh-water sponges below low tide mark one hundred feet from shore, and has been observed in good-sized colonies near the gill openings of healthy tadpoles of *Leptodactylus rhodomystax*.

Almost as common as *Vorticella*, in plankton, are colonies of *Epistylis*, but decidedly rare are the beautiful little sessile, cupped *Cothurnia*. *Opalina*, of several species, are common parasites of Amphibia.

PHYLUM II—PORIFERA

This phylum plays one of the smallest parts in the fauna of Kartabo. It is of great interest, however, in being one of the marine invaders of this fresh-water region—pioneers from the great oceanic fauna of sponges.

Class I—DESMOSPONGIAE

Family SPONGILLIDAE

The presence of fresh-water sponges is evident from any slide of plankton or river-mud debris, spicules being almost always visible,

mingled with the desmids and diatoms. Living sponges are not uncommon on disintegrating rock a hundred yards off the Laboratory beach, about a foot below low tide level. The rocks show colonies two to four inches in diameter, masses of spicules rising in glassy clusters like some strange crystals above the surface of the stone, the lower, living portion being covered with a thin, green veil of tissue. The spicules are very uniform, simple, smooth, transparent, slightly curved, blunt, almost truncate, thick and uniform in thickness throughout their length: they average .4 mm. long by .05 mm. in diameter.

Star-shaped spicules with six rays, and simple spicules with lateral irregularities are also found now and then in plankton.

Quite another type of sponge coats the under side of stones in one or two streams in the research area and especially in swift-flowing side streams of the Cuyuni above the first rapids. It is like a brown moss in life, and the spicules are very slender, simple, smooth, curved and needle-pointed at both ends, reaching an extreme length of 1 mm.

PHYLUM III—COELENTERATA

This is probably the least important Phylum in the research area, and as with Porifera, is an example of marine invasion. Both among the plants of *Victoria regia* and in the water of jungle creeks, I am always on the lookout for the fresh-water free-swimming medusa *Lymnocodium*, but have never found it.

Class I—HYDROZOA

Several times I have detected hydras, both green and brown, in bromeliad water, and twice a long tentacled form appeared in plankton debris from mid-river.

PHYLUM IV—PLATYHELMINTHES

Flatworms are common organisms in the research area, and few fallen logs are without one or more of the larger forms while as internal parasites they are less numerous. All four Classes are represented.

Class I—TURBELLARIA

The Kartabo Turbellarians or Land Flatworms are truly tropical in size and colors. Their habitat is rotten logs and dead bark, or less frequently the under side of moist jungle leaves. Some attain

a length of three inches. They may be leaf brown, with delicate shadings of darker along the edge, or mottled like lichens, or marbled grey and white, or with pink and black like the brevicipitid frog *Atelopus*. There is occasionally remarkable mimicry or at least a pattern paralleling that of slugs living in the same environment.

Class II—TREMATODES

Doubtless abundant, but I have observed them chiefly as parasites in fish; forms closely resembling *Cotylaspis* occurring in the gills, together with others quite unlike any usual type of fluke.

Class III—CESTODES

Tape-worms do not seem to be very abundant. Although no special search has been made for them they have been observed in all groups of vertebrates.

Class IV—NEMERTEA

A few small Geonemertean-like worms have been examined, living in decayed wood near the shore.

PHYLUM V—NEMATELMINTHES

Two Classes of Round Worms are present in the fauna of the research area.

Class I—NEMATODA

Parasitic round worms exist in enormous numbers as internal parasites in all groups from Arthropods to Mammals. Sometimes, as in the snakes of the genus *Xenodon*, large balls of hundreds of full-grown Nematodes are found in the intestine. A small round worm appeared under the skin of the instep of one of our members and lived for a week, moving slowly about until killed.

Filaria occurs as a parasite in the blood of most of the Indians and Bovianders or half-breeds who come to the station. It does not develop as elephantiasis as often as on the coast.

Class II—GORDIACEA

Hair worms are occasionally seen when dissecting insects, and several times dark brown ones, eighteen inches or more in length, have been caught in the water of the jungle creeks.

Class III—ACANTHOCEPHALA

These rotifer-like worms are common in the stomach and intestines of various fishes. A straight, oval form in *Pimelodus*, and a curved species in six or seven wholly unrelated types of fishes are both members of the family Echinorhynchidae.

PHYLUM VI—TROCHELMINTHES

Class I—ROTIFERA

Rotifers are abundant in all suitable places, infusions, creeks and river water, in isolated jungle pools and especially in bromeliads. Some are most remarkable forms and would well repay intensive study.

PHYLUM VII—BRYOZOA

Small colonies of *Plumatella* have been found in widely separated pools in the jungle, but this is one of the most poorly represented of all eleven phyla.

PHYLUM IX—ANNULATA

The true worms are represented by two Classes, the two remaining ones being altogether marine.

Class I- CHAETOPODA

Order I—POLYCHAETA

One of the greatest surprises of the Kartabo fauna was to find examples of this marine Order, so far beyond the reach not only of salt but even brackish water. When digging worms for bait in sandy mud close to the shore in H_3, in an area which is covered with water at high tide, Nereis worms were uncovered. When a six-inch individual was cut in half accidentally, a new head was regenerated in a few weeks at the front end of the posterior half. In 1919 in this extremely limited locality the worms were found to be fairly common. Two years later not a single individual could be found. They represent a new species.

Order II—OLIGOCHAETA

The Oligochaete fauna is a rich one at Kartabo; many species are common in plankton, in quiet jungle pools and swamps, and especially in bromeliad water. Very remarkable oligochaetes are occasionally seen in the latter environment.

Lumbricidae or earth worms are abundant both as to species and individuals. I have seen giants three feet in length living in swamp soil, while in every fallen log and under dead bark often high up in trees are small, scarlet, intensely active angle worms.

Class II—HIRUDINEA

One of the greatest distinctions between the jungles of Kartabo and those of the Eastern tropics is the total absence of land leeches in the former place. They are never seen on leaves or twigs, and for that matter are rare in any environment. Small ones are occasionally found in the water of creeks, and minute individuals in the gills of tadpoles and fish.

A large, five-inch, blood-red leech was once taken in mud. It showed little sign of external segmentation and had an extremely flattened head. After an hour in clear water it was found broken up into many small pieces, and had extruded a large Nematode.

PHYLUM X—MOLLUSCA

Although the Mollusca of the Neotropical Region are, as a whole, exceedingly abundant, this is not the case at the Kartabo Research Station. Whether due to the lack of lime or other cause, snails and slugs are far from numerous, especially as regards species. The group has not yet been worked up, but there are probably not more than twenty species altogether.

All but one of these are Gasteropods, of which about one-fifth are Prosobranchs, and the remainder Pulmonates.

An unnamed species of *Helicina* is found on the leaves of low jungle growths. This small, hairy form is an air-breathing Prosobranch. A giant banded *Ampullarius* is locally common in shallow water and near the coast forms the chief food of the hawk, whose beak seems formed especially for extracting the inmate from its curved shell. Clusters of greenish eggs of this snail are often seen on the stems of the mucka-mucka.

The giant among mollusks is *Orthalicus sultana,* extremes being four or even five inches in length, and conspicuously clouded and banded. Once during a short dry season, a large snail of this species aestivated on a beam at one side of the laboratory entrance, and we used it as a living knocker, beating a rat-tat-tat with the shell day after day without disturbing the hibernating occupant.

A new subspecies of *Auris distaeta* lives on leaves, sometimes

high up in the jungle. The most brilliant snail of this region is an unnamed *Corona*, with markings of yellow, brick red, grey and white.

Several species of large slugs of the genus *Veronicella* occur, brown or black in color, and are eaten by *Bufo marinus* and *Leptognathus variegata*.

On a few half-exposed rocks in mid-river are found a few bivalves, small fresh-water unios, probably of the genus Saxicava, the only representatives of this great group.

Mollusca is decidedly not a conspicuous or important phylum in this area of British Guiana.

Phylum XI—ARTHROPODA

Class I—CRUSTACEA

Crustaceans are in constant evidence along the tidal area, but inland they are seen only occasionally, in the shape of land crabs, or smaller types hidden within decayed wood.

Subclass I—Entomostraca

All the Orders of this group except the barnacles (*Cirripedia*) are represented at Kartabo.

Order I—PHYLLOPODA

Among many others, *Daphnia*- and *Bosmina*-like forms are abundant in river plankton. I have found eighty-two individuals of the former in the stomach of *Tomeurus*, a surface-feeding minnow, less than half an inch in length.

Order II—COPEPODA

Cyclops and related genera occur in jungle pools and also in bromeliads. In river plankton their perfect, cast skins are present in enormous numbers, and the living animals are sometimes so abundant as to appear like a fine milky precipitate.

Strange parasitic forms of *Argulus* occur in several species and in various places, such as the tails of tadpoles and in the mouths of Perai fish. An undescribed species of *Dolops* lives on big six-foot catfish.

Order III—OSTRACODA

Cypris and another closely related form occur in bromeliads.

Subclass II—Malacostraca

DIVISION I—ARTHROSTRACA

Order I—AMPHIPODA

Gammarus-like forms have been observed on three occasions but none collected.

Order II—ISOPODA

Parasitic Isopods are abundant, Cymothoidae on the gills of *Pimelodus* and other small catfish, and Bopyridae within the gill-covers of shrimps. This latter, a species of *Probopyrus*, is present on either the right or left side in twenty percent of the adult shrimps.

Sowbugs and pillbugs are abundant in the research area, under bark and in the wood of decayed fallen logs. The species are numerous. Small, dark-mottled Oniscidae, allied to *Philoscia* and *Porcellio* live under bark. I have found as many as seven in the stomach of a *Dendrobates* frog. Larger, dark-banded forms, fifteen millimetres long, with scarlet head and antennae, prefer moist leaves on the jungle floor as well as rotten wood. They belong to the marine family Ligydidae.

Armadillidae-like forms, rolling into perfect balls at the slightest hint of danger, live under bark.

At least eight species of Isopods have been collected in the quarter of a square mile, of which four are undescribed.

DIVISION II—THORACOSTRACA

Order I—DECAPODA

Suborder A—Macrura

While there are doubtless many species of shrimps, the most abundant of the river shallows is *Palaemon amazonicus* Heller. It occurs in great numbers and is caught and used as bait by the Indians. Small, split bamboo traps called *mahswas* are used expressly for this purpose. Smaller species are found far up in the jungle creeks. The river shrimps are omnivorous and scavengers, being attracted by various jungle seeds, dough, termite nests, or old fish and meat. A giant species, lobster-like in size, of the family Atyidae is much rarer. It is rich brown in color, striped with yellow and buff with delicate blue mouth parts.

Suborder B—Brachyrua

Several forms of crabs are not uncommon and one is abundant. The small mangrove crab lives in large numbers in the crevices of rocks, under stones and in the pockets of tree buttresses. Its favorite haunt is the mangrove roots up which it climbs for many feet.

One specimen weighed 2.1 grams, was 16 mm. between the eyes, and had been feeding on vegetable debris and small insects. There is great variation in color, the general tone being neutral, like the mossy or lichened or muddy mangrove roots, the chelae being dull yellow.

Large land crabs are found near the shore in the dry season and several miles inland during the rains. They are handsome crustaceans with the legs brilliant scarlet, the claws yellow, and the carapace purplish-black, bordered with pale yellow.

A female had eight young in her caudal sac on May 10. They were 10 mm. across the carapace. She was of large size with her chelae stretching laterally 200 mm. Her carapace was mahogany-colored, exactly like a mora seed.

Nine species of birds have been found feeding on crabs.

Class II—ARACHNOIDEA

Of the ten Orders of this Class, I have found seven at Kartabo. The Palpigradi have not yet been found although they are known to occur both in Paraguay and Texas; Solpugi have escaped notice although this is within their range, and I have detected no Linguatulid. These latter have been found in an autochthonus family of fish, so that all the groups are probably represented.

Order I—SCORPIONIDA

Scorpions are common under bark and in old rotten logs, but very rarely seen about the laboratory. Two families are most abundantly represented; Chactidae, to which the majority of the individuals belong, with thick, short chelae and two lateral eyes, and Buthidae, less common, with slender thin chelae and three lateral eyes. They breed during the rainy season and it is not uncommon to find a mother scorpion with ten to twenty pale colored young riding on her back.

I have been stung once and three of my staff have at various

times had the experience which is like that of the sting of a medium-sized wasp. Twice I have seen these creatures striving to defend themselves against the attacks of army ants (*Eciton*), by picking the ants off one by one, with their claws, but this sort of defense is useless against these terrible insects, and again and again the ants are seen carrying the segments and even the sting of small scorpions.

Order III—PEDIPALPI

Whip scorpions are rather uncommon; found in much the same places as scorpions, with a preference for over-shot banks and the hollows of trees. A pair which crawled out of a deep hollow when a purple-heart tree was cut down were very large, the whips of the male spreading twenty-three inches. These belonged to the family Tarantulidae.

Very small, tailed whip scorpions of the family Shizonotidae live in rotten wood. In six months of constant searching for termite nests in logs, one of my staff captured ten and saw about fifty.

Order V—PSEUDOSCORPIONIDA

Family CHELIFERIDAE

Members of the genus *Chelifer* are common in rotten logs, fifty or sixty having been seen in a day. *Chelanops* and closely related genera are rarer, and usually under loose bark. Single large specimens have been taken clinging to longicorn bettles and to common bats (*Molossus*), but usually these creatures are found on their volant hosts in pairs.

Obisium of the family Obisiidae has been found only in the stomach of a *Dendrobates* frog.

Order VI—PHALANGIDA

Harvestmen or daddy-long-legs are very abundant both as to species and individuals, more especially on the edge of glades and clearings and on the upper beaches. They spend the day under leaves and come out at dusk. They sometimes gather in large moss-like masses. Their principal diet inland is dead insects, droppings and half-rotten fruit, but the beach forms are aggressively carnivorous, and kill and devour ants, crickets and newly emerged dragonflies. Many superficially resemble our northern harvestmen, others are large and more brilliantly colored.

They seem unusually immune from molestation, as I have detected their remains in the stomachs of only three vertebrates, *Bufo marinus*, that most omnivorous of amphibians and of two birds, one a cuckoo, *Crotophaga ani*, and the other an antbird, *Sclateria naevia*.

Order VII—ARANEAE

Spiders perhaps lead the Arthropoda in point of species, and are second only to the ants and termites in actual numbers. They are as inconspicuous as the ants are dominantly visible, but a few seconds with a sweep net, or an examination of under foliage, or rolled leaves, reveals the enormous numbers of these creatures.

Some fashion individual webs of great beauty, while others build communal webs extending over many square yards and forming excellent collecting places, where many interesting insects become entangled. Leaping spiders hunt down their prey, flower spiders bite out parts of blossoms and sit in the gap, simulating the lost petals, small tarantulas nest in curled up leaves or build subterranean trap-door tunnels in the laboratory compound, others of the largest size inhabit the roof of the Station bungalow, and vie with us in hunting insects attracted to the lights. The variety of habits, forms, patterns and colors of spiders is endless and the group would form a splendid subject for research.

They occupy a midway position in the life and death struggle of these tropics—feeding on living prey of many kinds, and being themselves the sole food of hundreds of species of organisms. With thousands of hymenoptera hunting every leaf and twig to store their cells and caves, and with flocks of hungry birds and scores of lizards searching for food every hour of daylight, it is a wonder that these soft-bodied creatures can keep from extermination.

Besides their many Arthropod enemies I have found spiders in the stomachs of two fish, three amphibians, four reptiles, one mammal and no fewer than fifty-three species of birds.

Order VIII—ACARINA

Mites are exceedingly abundant, being found on all sorts of hosts and in every conceivable environment. Unattached ticks are rare in the jungle and it is seldom that I see more than one a week. The scavenger mites, Gamasidae, are found on many hosts, weevils being the commonest. Large-sized ticks, Ixodidae, are found singly

on snakes, lizards, amphibians and mammals, and very rarely on birds.

Harvest mites, Trombidiidae, locally known as bête rouge, are troublesome at times and places, especially in grass, although I have never known them to be as bad as on Long Island and the Virginian coast. They persist throughout the year, but are more abundant, or at least more irritating, in the dry seasons. The human blood seems to develop an immunity to the irritation of these mites, and after a few weeks their presence is seldom noticed. Almost every individual mammal, bird and land reptile is infested with these pests, usually in the form of clusters on various parts of the head.

A very few birds and lizards feed on mites, and the very tiny, newly-emerged *Bufo marinus* often make them their chief food.

Order X—TARDIGRADA

Two water-bears have been observed in a slide of water from mangrove bromeliads.

Class III—TRACHEATA

DIVISION I—ONYCHOPHORA

Peripatus is not rare when searched for in rotten legs, both in deep jungle and in clearings. Three were found in a certain rotten log lying out in full sunlight in the laboratory clearing, and two more in the same place a year later.

I have collected five back of the laboratory in the open clearing among the stems and roots of short grass, where there were no logs or wood of any kind, and very little protection from the sun's direct rays. They live well under damp bark, and I have had as many as eight young born from a single female.

DIVISION II—MYRIAPODA

Millipedes and centipedes are common, some of the former abundant, climbing up the trunks of trees, under bits of loose bark and in rotten logs; centipedes in dryer places, rarely in tents and dwellings. The bite of one of the twelve-inch centipedes would doubtless be very unpleasant, but certainly not dangerous if treated.

Millipedes would seem but indifferent food, yet many organisms choose them. Among others, millipedes are eaten by black cuckoos, *Crotophaga*, by *Thamnophilus* and *Formicarius* among antbirds,

Fig. 9. *Peripatus*, one of the most primitive of Arthropods. It is viviparous, and three newly born young are seen in this picture. Photograph by John Tee-Van.

Xiphorhynchus and *Dendrocolaptes* among woodhewers, besides *Bufo marinus*, *Dendrobates*, *Ameiva* and *Plica*. Centipedes fall victims to the same species of birds with the addition of the hawk, *Leucopternis*, the antbird *Hylopezus*, and a jay *Cyanocorax*, in addition to *Bufo typhonius*, anolis lizards and the mammal coatimundi, *Nasua*.

Small, many-segmented, dark-colored millipedes of the family Julidae with eyes in clusters are fairly common and are eaten by *Ameiva* lizards, but by far the most abundant millipedes are the big brown Polydesmids, on trees, in fallen logs and under bark. There are nineteen body segments, they are two to three inches long, and roll up at a touch. When annoyed they exude an ill-smelling brown liquid, and are altogether forbidding as food, yet the insatiable *Bufo marinus* seem to enjoy them.

Giant centipedes with twenty-one segments, *Scolopendra*, are found occasionally, the largest so far being thirteen inches long. Two nine-inch ones were taken in a tent and a smaller individual was seen on a lofty dead branch feeding on a buprestid beetle. In the low jungle these are replaced by small ones, of twenty-three segments, with long, whip-like hind legs; all, however, are decidedly uncommon. Notophilidae and Geophilidae are represented by small-sized centipedes in rotten logs and on jungle debris.

DIVISION III—INSECTA

It would be indeed a rash thing to attempt an adequate survey of the insect life of even this quarter square mile of tropical jungle. Our present knowledge of it is most fragmentary, but sufficient to indicate the general relative abundance of the various groups and to reveal the dimensions of this extraordinary field of research. Together with birds, the insects assuredly hold the position of dominant organisms of the present day at Kartabo.

EVERY ORDER OF INSECT IS REPRESENTED AT KARTABO

I—Thysanura	XIII—Parasitica
II—Orthoptera	XIV—Thysanoptera
III—Isoptera	XV—Neuroptera
IV—Euplexoptera	XVI—Mecoptera
V—Mallophaga	XVII—Trichoptera
VI—Corrodentia	XVIII—Lepidoptera
VII—Zoraptera	XIX—Coleoptera
VIII—Plecoptera	XX—Strepsiptera
IX—Ephemerida	XXI—Diptera
X—Odonata	XXII—Siphonoptera
XI—Hemiptera	XXIII—Hymenoptera
XII—Homoptera	

Order I—THYSANURA

Suborder I—CINURA

These lowly insects are abundant, no rotten log or mass of dead leaves being free from so-called fish-moths. They are free living, many as long as eight or ten millimetres, usually pale yellow, and very active, scurrying about the porous wood, and so delicate that they are very difficult to capture without damaging antennae or cerci. Smaller, translucent green forms are found in myriads on the under surfaces of leaves and still others such as *Atelura* are termitophilus or found associated with ants. *Nicoletia* is also not uncommon.

Suborder II—COLLEMBOLA

Collembola are less numerous than Thysanura, but occur in much the same places. One of the most remarkable forms is a little creature of a wrinkled, velvety indigo color, with a reduced springing apparatus. Others, Poduridae, are abundant not only on

rotten wood but in the debris of the upper beach, where they gather at night in hundreds about half-rotten fruit or other organic flotsam and jetsam. *Borecus pinnatus* is very abundant in termite nests. One group of tiny wasps, *Microstigmus*, stock their hanging, bell-like nests with nothing but spring-tails.

Order II—ORTHOPTERA

Family BLATTIDAE

The common roaches of the bungalow are wide-spread species of *Periplaneta* and *Pycnoscelus* which, until we encouraged tarantulas and geckos, gnawed our clothes and books, and destroyed all insect specimens which were not kept on swinging shelves.

In the jungle, roaches outnumber all the other Orthoptera, occuring chiefly among fallen leaves and debris, but as they enter into the food of many tree-climbing and leaf-searching birds, they must be almost universal in their love of hiding places. At least a score of species may be called abundant or common.

Family MANTIDAE

Egg-cases, newly hatched broods and full-grown mantids occur everywhere that green leaves are found, but they are common rather than abundant. The majority of the species are brown, but others are green, with sometimes discolored or transparent spots. Some are ornamented with brilliantly colored ocelli and other patterns, while the flower mantids vie with any orchid in coloration.

These insects are readily kept alive for months, exhibiting interesting feeding habits, now and then depositing a mass of eggs, and becoming quite tame. Two lizards and at least five species of birds include mantids in their diet.

Many jungle forms fly to our lamps at night. Over twenty-one well-known species have been taken, besides many still undescribed.

Family PHASMIDAE

It is in this family that tropical Orthoptera reach their most bizarre development. On the leaves and branches of low bushes in clearings, in mid-jungle and on the foliage of trees which are chopped down, are found walking sticks, minute, medium, and occasional giants eleven inches long. Some are smooth and enamelled, others roughened, or with foliaceous excrescences: wingless, or with tiny parodies of wings, or fully functional expanded membranes: and

finally insects which appear to be nothing but animated green, veined leaves.

When the wings are too small to fly with, they often function as flash organs. A stick insect will suddenly snap open a sheet of brilliant yellow and scarlet, the colors shooting out from an apparently dead twig, in the most startling manner.

These insects have learned to support themselves on three or four legs, and to dangle the remainder in midair; they also sway when disturbed, as if a breeze were moving them. They do not do well in captivity.

Family ACRIDIIDAE

The short-horned grasshoppers are first among the families of Orthoptera in numbers, and they swarm in every open glade, and especially in clearings. They fly up at every step and their flight is directed invariably toward or into the shelter of the denser jungle. About thirty species are common.

Tribe TETTIGIDES

Ten species of the little tettix hoppers, with solid dorsal armor, are common and found almost exclusively on the trunks of dead or fallen trees. They are remarkably like the hue of their particular trunk, and within fifteen feet I have found a brood of very dark tettix on a dark-barked trunk, and pale, mottled ones on a tree covered with parti-colored lichens.

Tribe TRYXALIDES

These stick grasshoppers are such good imitations of dead twigs that they choose to rest quietly on branches quite exposed throughout the day, waiting for night to come. Or if they become too hungry, they begin eating the edge of leaves with very slow and deliberate movements, scarcely to be distinguished from the motion of the leaf on which they rest. Head, body, antennae, legs, all are twiggy, and so completely do they trust to their invisibility that they may be picked up without careful approach. They are common but never abundant.

Tribe ACRIDIIDES

As in northern lands, these "meadow" grasshoppers are the dominant form of Orthoptera. As members of the same tribe we must count the tropical giants which reach a length of six inches,

whose wings when spread in flight are as large as those of a good-sized bird, and more brilliant than many. These insects prefer the edge of the jungle and clearings.

Another large form is clad in a livery of scarlet and black, and the wingless mynphs appear in a solid phalanx of one or two hundred, travelling steadily through the jungle or across a grassy clearing, walking slowly, and hopping only when frightened. They show no fear of birds or lizards, and although anis eat them, and an occasional one is found in an *Ameiva's* stomach, they flaunt their brilliancy because of a general immunity. All my pet monkeys and birds refused them, even when sandwiched in between edible species which were seized and eaten ravenously.

Jungle grasshoppers are found singly, many with leaf markings, or a broad ruptive streak down the back, and often with hidden flash colors, such as scarlet inner thighs, or abdominal tints, visible only in flight.

Family TETTIGONIIDAE

Long-horned grasshoppers are almost all extremely protectively colored, and as they are nocturnal, discovery of them in the daytime is usually accidental. They frequently come to light. Under the leaves of bushes and trees the narrow and broad-winged katydids rest, climbing to the upper surface and becoming active just before dusk. The extreme to which hypertely is carried is astounding—green leaves gnawed and jagged around the edges, leaves decayed to red and yellow hues; leaves with a center of skeletonized network; most of these belong to the tribe Meconemides.

A second tribe Mecopodies, is represented by fewer numbers, but very striking species; great three-inch, winged forms, lichened in hue and texture, living on tree-trunks and old logs, and brown-leaved long-horns clinging to bare branches like the last dangling sear leaf.

Family GRYLLIDAE

This family ranks fourth in numbers and conspicuousness, but in audibility it stands first. Of the seven known tribes, all occur at Kartabo, five are common, two rare, although Myrmecophilides would undoubtedly be recorded more frequently if the nests of ants were searched systematically. I once found representatives of all seven tribes of Gryllidae in a single day. Crickets are found from the very margin of the river to the highest dryest jungle, but seldom

at a greater elevation than a few feet from the ground, while the majority are wholly terrestrial. The season makes some difference in their numbers, and more in regard to their singing—the season of mating being dominantly the early part of the two rainy seasons, about May and November. Three tribes come occasionally to light, but singly and only on rainy evenings.

Tribe TRIDACTYLIDES

Common and sometimes abundant along jungle trails is *Rhipipteryx,* a black and white member of this interesting and little-known tribe. They are not wary, but are very conspicuous, and when frightened escape by tremendous leaps, followed by a long scaling flight. They feed upon the juices of decayed wood, and perhaps of leaves as well, and are sometimes found in scores in and on a single dead log.

The hind legs have been so modified for leaping that they have quite lost their walking function, and these insects are wholly quadrupedal. I have twice detected robber flies, Asilids, in the act of devouring these Orthoptera.

A very minute, closely related, similarly modified insect is found on the sand of the beach in company with springtails, and newly-hatched mole-crickets.

Tribe GRYLLOTALPIDES

There are two general types of mole-crickets at Kartabo. A large, very pale species confined to the sandy beaches and a smaller black kind, which occasionally comes about the waste baskets. Both are attracted by light, the beach one more frequently.

The littoral species is always to be found after dark, running over the sand. At the very edge of the water at low tides many young ones often run about, and individuals of all sizes are occasionally seen swimming. They are very fierce and cannibalistic, and if several are confined together, one only will be found in the morning. In the daytime holes and long tunnels are visible. There is no doubt that these insects spend the time of high tide hidden in the sand, beneath the water. When placed in a thick layer of sand and covered with water, they are well and lively after eight hours' immersion.

Tribe GRYLLIDES

The true crickets are represented by a number of species, most of which have habits similar to those in the north. They are usually

terrestrial, and in the jungle very tiny black ones are found under the fallen leaves. Others live beneath bark. Some of large size and others with square, yellow-rimmed wing covers, are very fleet of foot, and flat enough to creep into the smallest crevice. Tiny pale brown crickets come to the lamps in the evening, and numerous small, nocturnal voices are doubtless traceable to insects of this group.

Tribe OECANTHIDES

Although arboreal crickets are found in the highest jungle trees, true crickets are rare and I have seen but two individuals of a small green form, closely resembling a similiarly colored species of Trigonid.

Tribe TRIGONIDIIDES

The beautiful little Harlequin crickets prefer the more open trails and clearings to the darker jungle, and are found on bushes and low-growing vines, seldom quiet but running rapidly about, with palpi rapidly vibrating.

There are a number of species, almost all of bright coloring, although one is dull brown and another pale green. The nymphs of one Harlequin afford the most perfect mimicry of ants I have ever seen. The resemblance is exact to every superficial detail, the telltale thick hind femora being of a pale translucent green, which is invisible against almost anything, and yet ready at an instant's warning to carry the wingless insect at least a hundred times its own length. They associate with certain ants with impunity, and I have seen them crawling over membracids in company with a crowd of ants. In the ant mimics, the antennae are short, but in others which are very like small wasps, the antennae, while long, are amputated by a terminal white portion, reducing the optical length to the correct hymenopteron extent.

Tribe ENEOPTERIDES

A large jungle leaf-cricket is the most abundant of its family at Kartabo. It lives on leaves in the jungle, or among bushes of the clearings. It is leaf-brown above and black on the sides, the color division cutting abruptly through face, antennae, eyes, body and wings. It is a persistent singer, and easily located from 5:00 P.M. until dark, on a leaf of some low bush, with wings elevated at right angles to the body, and hind legs drawn up to the same angle.

The song is a true trill, less than half a note apart, the wings vibrating slightly, but not enough to blur them. The tone comes in successive waves and is about an octave below middle C, although the quality makes it difficult to key it.

Order III—ISOPTERA

From the point of view of an intruding human being, termites or "white ants" rank second in a list of dominant organisms at Kartabo. These insects are without doubt the chief agency in the disintegration of dead wood in the tropics, with the consequent rapid return of the decaying plant material to the soil, thus making possible its utilization for the growth of other plants that spring up in place of the trees that have fallen. The burrows of termites also open the way for the invasion of molds, fungi, bacteria and water, which further the process of decay. It is Prof. Emerson's conviction that much of the luxuriant and rapid growth of plants in the tropical forest is owing directly to the activities of these insects. The habit of using sand and dirt in the construction of nests together with the burrows that many species of termites make in the soil, results in the mixing and aeration of the soil.

In addition to these two influences which termites exert with the consequent enormous effect on the plant life of the region, these insects are so abundant in numbers that they form the chief food supply for a number of animals, particularly three species of ant-eaters, *Myrmecophaga*, *Tamandua* and *Cyclopes*, two species of burrowing snakes of the genus *Leptotyphlops*, and several species of woodhewers, woodpeckers and antbirds, such as *Glyphorhynchus*, *Chloronerpes* and *Formicarius*. Certain social wasps of the genus *Polybia* collect the winged forms as well as soldiers and workers, and several Ponerine ants (especially *Neoponera commutata* Roger) raid the open termite trails and enter their nests. During swarms almost every insectivorous creature from centipedes and spiders to hawks and bats feed largely upon these insects, and such unsuspected animals as terns and monkeys.

The nests of the termites, both terrestrial and arboreal, on account of their constant temperature, permanency, food supply of termites or debris, and because of the social instincts of the termites, offer a haven to numbers of specially adapted animals, mostly insects, which are fed and often even reared by the termites themselves. Over fifty species of arthropods have been found in termite

nests near Kartabo, forming with the termites, remarkable biocoenoses, with fascinating and remarkable interrelationships between the animals composing them. Birds such as trogons and parrakeets, and the large tegu lizards make their nesting burrows in the very heart of termite nests.

The intensive study of Kartabo termites from the quarter square mile of jungle, carried on by Prof. Emerson, demonstrates the great value of such restricted research. Until his studies began, there were sixteen species of termites known from the whole of British Guiana. He has now recorded from the tiny restricted fraction of the Colony under investigation, eighty-five species, which means that the completed census will most certainly tally over one hundred forms.

Order IV—EUPLEXOPTERA

Earwigs are much rarer than in the jungles of the Eastern tropics, where in Borneo and the Malay States I have found them in great abundance. At Kartabo they occur in varied environments, under stones near the water, under bark of dead trees and among leaves. An interesting blind form was dug up four feet beneath the surface of undisturbed soil.

Order V—MALLOPHAGA

Mallophaga or bird lice are found epizoic upon almost all the birds of this region, and a considerable number of mammals. Although I have collected them from many hundreds of freshly-killed vertebrates I have never found them occurring to excess.

Order VI—CORRODENTIA

These curious little insects have been observed several times in the jungle, twice under bark on hard, undecayed dead wood. In the laboratory Psocids or book lice are found in numbers running about the inner bindings of any book which is not in frequent use.

Order VII—ZORAPTERA

This exceedingly rare order of insects is represented thus far by a single wingless specimen captured in a termite nest.

Order VIII—PLECOPTERA

The little known stone flies are rare, and only a very few larvae and adults have been observed, the former in the sand of Cuyuni creeks.

Order IX—EPHEMERIDA

Mayflies are common and at certain seasons abundant, immense swarms emerging at one time, and dancing in mid-air. The one most frequently seen is a large form with a line of silvery white down the back of the abdomen. I have watched a vast swarm of these insects twenty feet up, dancing for hours. Facing upwind, they hold the wings steady, slowly sinking for a few seconds, when with a single downward sweep of the wings, they regain their former altitude, and again float like tiny airplanes for a time. Occasionally the surface of the rivers is covered with their wings and bodies.

Among many others, a species of *Campsurus* with its degenerate meso- and meta-thoracic legs is common about the laboratory lights in the rainy seasons.

Order X—ODONATA

A great many species of dragon- and damsel-flies have been taken in the quarter mile research area, but no attempt has as yet been made to identify them beyond families. Of the first mentioned group, all four families are present.

To the Gomphidae belong good-sized insects which keep to the vicinity of water. Although not as swift fliers as some others, they are not often seen or captured, for they usually fly among thick undergrowth.

The largest dragon-flies belong to the Aeshnidae. They are haunters of the jungle and come to any pit or tub of water however small. When I sink a tub for aquatic Coleoptera a single large *Epiaeschna* or *Nasiaeschna* appears at once and takes possession. It drives away any related intruders, and flies back and forth over the diminutive pond, occasionally laying an egg in a crevice of the soil near by. When at rest it hangs suspended from a leaf, with the wings, which spread four or five inches, opened and flat. They are far from wary insects and will alight on one's hat or clothing. Members of this family are often seen hawking about in the air in close association with martins and swifts, feeding on swarming termites or ants, and they join the bats in crepuscular hunting as well.

Smaller dragonflies belong to the Cordulidae, and have the wings usually quite clear, and the abdomen often of a deep purple or red color.

Numerous species, some very common, are included in Libel-

lulidae, often with banded or spotted wings or dashes of color. They are the typical dragonflies of the jungle trails and of dry clearings far away from water.

Two families of the damsel-flies Zygoptera, vary in size from the most delicate, azure-bodied beings, fluttering tremulously on the tiniest of gauzy wings over creeks, swamps and the shores of the river, to the marvellous, giant *Mecistogaster* of the high jungle. These have wings which expand five and six inches and slender abdomens which trail out behind to an equal length. Their wings may be clear, or tipped with spots of yellow or white, and in shadowed aisles of the jungle these terminal spots, weaving about in confused motion, are often the only part of the insect visible to the eye of the onlooker. They breed in the water of the bromeliad leaves, high up on the trunks and branches of trees.

The smaller damsel-flies have brilliantly colored bodies and sometimes spots of scarlet on the wings. Agrionidae is the more abundantly represented family.

Nymphs of Odonata are abundant in all conceivable aquatic places, in the waters of creeks, both slow and rapid flowing, along shore and even in the deep water of the river, in isolated pits and the water of air-plants.

Order XI—HEMIPTERA

CRYPTOCERATA

The distribution of these is of course restricted to water, which, apart from the rivers, consists of temporary rain pools, mica pits, small creeks, and, in the vicinity of the laboratory, flooded pit traps. Certain Hebridae and Notonectidae frequent these places. The bromelias found on the mangroves harbour at least two species of Hebridae.

Group GYMNOCERATA

Judged from this standpoint the immediate neighborhood of Kartabo seems to support two distinct groups of bugs. The first, and larger, both in number of species and individuals, belongs to the clearings, and as might be expected, this hemipterous fauna does not appear to differ very greatly from that of the cleared plantation lands near the coast. Indeed, it is probably immigrant, and likely to extend in range as the cleared land increases in extent. The second, and apparently smaller, is probably the older fauna, native

to the primeval jungle, in which the clearings are made. It should be understood that the terms aboriginal and immigrant are used merely for convenience in this connection. The neighborhood of Kartabo has been occupied by Dutch and British settlers for the last three hundred years at least, and the addition of forms from more open country to the original forest fauna must have taken place throughout this time. Except perhaps as regards the carnivorous bugs, this jungle fauna is more restricted both in species and individuals than that of the clearings. In both cases, the relative abundance of different species in proportion to the number of individuals obtained is very marked. The occurrence of the different species is probably influenced considerably by rainfall and other climatic factors, as Hemiptera of all families are relatively more abundant in September than during the rains of June and July. Three large families of Heteroptera predominate in the area, Reduvidiidae, Coreidae, and Pentatomidae, in numbers both of species and of individuals. The first family is abundant in jungle and clearings. These three families include species of every size, and in the Reduvids of considerable diversity of form.

The Pyrrhocoridae and Anthocoridae include none but small forms, mostly confined to the clearings, and the same may be said of the Phymatidae.

Family PENTATOMIDAE

This is a large and dominant group. Some of its numbers are conspicuous in size and coloration, others are small, sober-hued forms. On the whole, the Pentatomids frequent clearings and sunny trails, although certain forms of considerable interest are confined to the deep jungle.

Family COREIDAE

Perhaps the most remarkable group of Heteroptera in size, number of species and diversity of form are the Coreidae. Coreid bugs are found in the clearings and in deep bush. Some exhibit curious and almost grotesque developments of the antennae and limbs; others are brilliantly colored, perhaps to repel enemy attacks, or else are inconspicuous to avoid being observed. The nymphal stages are frequently very different from those of the adult; and some species appear to live on decaying organic matter rather than on plant juices.

Family LYGYDAE

In comparison with the above the Lygydae are not only less abundant in species, but the individuals are less conspicuous in size and coloring.

Families ANTHOCORIDAE, CAPRIDAE, PYRRHOCORIDAE

These are represented at Kartabo by a number of small forms, generally obtained in the clearings by sweeping, and readily overlooked.

Family PHYMATIDAE

Represented by a few species frequenting open places. The same forms are much more abundant in the grasslands near the coast, and may even have appeared up the river comparatively recently in the wake of negro settlers and consequent clearing of jungle.

Family ARADIDAE

A few interesting bark-dwelling forms, protectively colored, are found on tree trunks in the jungle.

Family REDUVIDAE

Ranks with the Coreidae as one of the dominant families. There is great diversity of form, size and habitat. Certain species show remarkable resemblance to insects of other groups inhabiting the same area. Thus one "mimics" a sawfly, another an ichneumonid, two others resemble two different pompilid wasps, another apes an inconspicuous grasshopper, and so forth.

Order XII—HOMOPTERA

Family FULGORIDAE

The most striking of these insects are the huge lantern- or peanut-headed insects which are seen very rarely on tree-trunks. Smaller fulgorids of the most bizarre shapes and colors are more common. A very typical jungle form is a large insect with black wings covered Kartabo quoise dots, and a remarkable tuft of long, curving, waxen and larger t the end of the abdomen. They are sometimes common, the clearing he trunks of trees, and present a very curious sight when not appear t
lands near the

Family CICADELLIDAE

to extend in perhaps the most abundant of the volant Homoptera second, and appa

in the Kartabo fauna. They are mostly small, with very brilliant colors and striking pattern and seem to court observation by alighting conspicuously on the upper surfaces of leaves.

Family MEMBRACIDAE

Abundant, especially in half-over-grown clearings, where eggs, immature and adults spend their lives on a single stem, attended by their guardian and shepherd ants. The forms are beyond description in weird outlines, hooks, humps, knobs, blades, handles, pillars, curved projections forming absurd initials (in one case E L). All this elaborate protection is inexplicable, as no creature seems to feed on them, and most of the adults have the advantage of eyesight, leaping powers and wings. Seventy-four species have been recorded, in an unpublished monograph by Maud D. Haviland, of which twenty-six have proved to be new to science. Almost all are tended by ants of various species.

Family CERCOPIDAE

Frog-hoppers are common, a few abundant, many dull-colored, others brilliant, but not as a rule of unusual shape. By far the dominant form is *Tomaspis ruber*, black with two conspicuous yellow cross-bands, which always alights and remains in full view.

Family CICADIDAE

While not abundant as collecting goes, cicadas are aurally the most dominant form of insect life, their voices rising above all other sounds during the dry season. They range from very large to small forms, some with curious ocelli, others very like our northern cicadas. A common form with brown wings is frequently attracted to our lights in the evening, while others come more rarely. The "six-o'clock bee" of the colonist is a cicada, and is so-called because of its regularity of utterance each evening. Some of the jungle cicadas call from high up in the trees with vibrations of tremendous power, either single notes, or two, separate at first and merging into a true trill. Only once have I found cicadas gathered in any numbers, in May, when I observed thirty-six on the stems of a low Dalli sapling.

Five birds and a lizard are known to feed upon cicadas in the research district.

Family PSYLLIDAE

Two mutilated specimens have been taken from the mouth of a tiny frog. A few living species collected, one being an interesting gall-forming type, causing malformations which harbor a number of parasites and inquilines whose bionomics are very complicated.

Family APHIDIDAE

This family is mentioned to emphasize its almost complete absence, its place being taken by membracids. Only two true aphids have yet been found at Kartabo. They are not rare on the sea-coast.

Family ALEURODIDAE

The commonest member of this small group is an active larva which crawls over the leaves completely concealed by an astonishing growth of long flaxen filaments which project in every direction. Other nymphs are tended by ants. Winged adults are seen more rarely flying about among the leaves and low bushes of the jungle.

Family COCCIDAE

Coccids are legion, both unattached and in intimate association with ants and other insects. Sometimes a tree-trunk will be almost completely covered with small earthen mounds, each of which is a stable built for a coccid by some species of ant. Large brilliantly colored ones are found in the nest of *Azteca*, but for the most part they are dull of hue, or covered with a whitish exudation of wax.

Order XIII—PARASITICA

If one watches the daily ministrations of the Indians and native Boviander mothers to their children, the presence of representatives of the family Pediculidae cannot be doubted. No true lice have been found on any of the jungle mammals.

Order XIV—THYSANOPTERA

Thrips are found in every likely and unlikely place, most abundantly in flowers and under bark. On recently fallen trees scarlet immature thrips will suddenly appear in uncountable numbers under the bark, creeping out in the blazing sun of midday to go through most remarkable dances. They disappear as quickly as they come. The adults are far less numerous and fly with great difficulty, sometimes collapsing after a few inches of aerial progress.

Order XV—NEUROPTERA

Family HEMEROBIIDAE

Only the larvae of these insects have been observed, and rather rarely, walking about on leaves in the jungle, each presenting a most curious appearance in being completely covered with bits of debris, its own old skins and the skins of the insects it has eaten, all fastened together with silk.

Family CHRYSOPIDAE

The presence of the delicate lace-winged flies is more often indicated by their curious stalked eggs than by the larvae or imagos themselves. Often along the edge of a leaf, and sometimes on articles in the laboratory, lines of the long-stemmed, knobbed affairs are seen, each egg supported on a long, slender hair. The debris-covered larvae, encased usually in the down or hairs of plants, are found on leaves and stems in the jungle, which after a short pupal phase, also in a mound of detritus, emerge as the beautiful golden-eyed adults. These come occasionally to light, and I have reared them in stender dishes.

Family MYRMELEONIDAE

I have seen no ant-lions in the jungle, either the pits of the larvae or the adults. The dry sand under the laboratory is pitted with their traps, and the adults are taken now and then. Others are found in the clearing near the jungle, and in old Indian cassava fields. An inch or two below the surface of the sand are found the globular sandy cocoons, the enclosing grains held tightly together with silk, and, if the adult has emerged, holding the perfect cast pupal skin.

Family ASCALAPHIDAE

The adults, looking like ant-lions but with long, butter-fly-like antennae, come occasionally to light, and the larvae are found on leaves, looking strangely out of place. In shape they are like ant-lion larvae, but instead of being humped, they are unbelievably flat, and when resting on a bit of brown leaf are quite invisible.

Family MANTISPIDAE

Decidedly rare in the research area. A large insect, apparently a wasp, flew from a tree-trunk directly on to my sleeve, one day. I brushed it off, and when it flew again and again at me, I retired

hastily, for a sting from a large tropical wasp often means a few days of fever. It flew after me and alighted on my gun, when I recognized it as a remarkable mantis mimicking a wasp. Not until I later pinned the insect did I realize that I had twice been fooled, and that it was in reality a member of this family, and quite unrelated to the Orthopteran mantids. I once found the remains of a mantispid in the stomach of a woodhewer, *Dendrocincla*. The larvae and pupae of mantispids have been found in cells made by spider-storing wasps in the nest of one of the Armitermes termites.

Order XVI—MECOPTERA

All I know of scorpion flies, *Panorpidae*, is that now and then the adults come to my light at night in the laboratory.

Order XVII—TRICHOPTERA

Caddis flies play but a small part in the fauna of Kartabo. Imagos come now and then to our lamps in the evening, but the larvae and their cases are common in the river and locally abundant in the jungle streams. Under stones in front of the laboratory are small scarlet forms living in soft linear cases made of muddy debris; also the more attractive *Helicopsyche* occurs, tiny mosaics of sand grains resembling coiled mollusk shells. In creeks farther up-river are large caddis-worms inhabiting houses of large pebbles, held together with a silken web. The larvae themselves are most remarkable, with elongated gills on the protected areas of the body, the anterior segments being hard, and the whole of most brilliant, varied colors, some individuals dominantly turquoise blue, others green..

Order XVIII—LEPIDOPTERA

The moths and butterflies form one of the most conspicuous groups of insects to be found within the quarter square mile of research area at Kartabo. The range of color and size among them is great, the size varies from minute micro-lepidopterons smaller than mosquitoes, to great moon moths, twelve to fourteen inches across the wings; the colors range from dull grays and browns through the chromatic scale to the brilliant, metallic-blue, refraction iridescence of the morpho butterflies.

The number of species observed and taken at Kartabo is very considerable, about 1215 in all, of which about 401 are butterflies and approximately 814 moths. It is probable that half as many again remain to be recorded.

Suborder HETEROCERA

For some wholly unknown reason sugaring and jacking are almost failures as regards moths at Kartabo. One hundred miles away in the Northwest District of Guiana I have had remarkable success with both methods, but at Kartabo none of the dozens of attempts has produced any but negative results. Hence the collection has had to consist of the casual individuals which flew into the bungalow on rainy nights, or whatever species were alarmed and caught in flight in the daytime, or what could be reared from larvae. Jungle moths are at the height of their abundance about mid-Sepetmber. The 800 forms recorded probably represent only a very small fraction of those actually present.

The following twenty-three familes of moths have been taken in the research area at Kartabo:

Sphingidae	Notodontidae
Saturniidae	Liparidae
Ceratocampidae	Melalophidae
Castniidae	Cicinnidae
Hypsidae	Eupterotidae
Amatidae	Lasiocampidae
Arctiidae	Cossidae
Noctuidae	Dalceridae
Periopidae	Limacodidae
Geometridae	Megalopygidae
Uraniidae	Pyrolidae
Epiplemidae	Micropterygidae,

besides a host of Microlepidoptera.

These comprise in all 814 species of moths, rather unevenly distributed, as the three families of Noctuidae, Geometridae and Pyralidae include 55 per cent. of the whole number. Among the more interesting are the following:

Family SPHINGIDAE

Although fairly strong in number of species, the family of sphinx moths is not especially abundant in individuals, and these are seldom seen unless searched for in the vicinity of sweet-scented nocturnal blossoms. One form of day-flying hummingbird moth is common, and always to be found at four in the afternoon in the clearings, about the Mazaruni primroses, *Sipanea*.

Family SATURNIIDAE

Fairly well represented, mostly with conspicuous ocelli on the hind wings, and usually clad in shades of brown and dull yellows. *Therinia* is a beautiful and abundant form, resting flatly and conspicuously on jungle leaves, and closely resembling a white fungus patch or the excrement of a bird.

Family CERATOCAMPIDAE

Three species only have been collected, two of which are large and very beautiful.

Family CASTNIIDAE

Three species; one very large. The commonest often escapes observation when at rest by a very close resemblance to an orchid. On the coast this family is one of the worst sugar-cane pests.

Family HYPSIDAE

Small, rare and very beautiful moths, superficially resembling several forms of Rhopalocera.

Family AMATIDAE

Sixty-odd species of these exquisite little creatures. The dominant character of the Amatids is the resemblance of many to wasps. Both in transparency of wings, constricted abdomen, coloration and especially in the habit of curving the abdomen quickly around, these so closely mimic stinging hymenoptera that we have been deceived again and again. *Correbia* is almost exactly like *Calopter* among the Lycidae coleoptera.

Family ARCTIIDAE

Fifty species, mostly small, but of the most exquisite colors and patterns.

Family NOCTUIDAE

Over 150 species of bewildering variety from the tiniest of little brown "millers" to the giant *Erebus* moon-moths twelve to fourteen inches across the wings. Chiefly leaf-brown and grey in color.

Family GEOMETRIDAE

Eighty species defying any résumé, so widely diverse are their extremes in color, pattern, and size. All are delicate, and many show soft shades of green. Perhaps the most common moth at Kartabo

is the exquisite *Chrysocestis*—whose wings are tiny sheets of mother-of-pearl, bordered with sealing-wax drops of gold.

Family URANIIDAE

With only two species, this family is more in evidence to the casual observer at Kartabo than a half dozen other groups with scores of forms. *Urania*, the big, green, day-flying moth, is common in migration and flying over the water every week in the year, and few days pass without a dozen or more being seen.

Family PYRALIDAE

Over one hundred small, inconspicuous moths of this vast group have been collected and named, and probably three or four times this number await more careful search.

Suborder RHOPALOCERA

Four hundred and one species of butterflies, representative of the following twelve families have been found at Kartabo:

Papilionidae	Heliconiidae
Pieridae	Nymphalidae
Danaidae	Riodinidae
Satyridae	Erycinidae
Brassolidae	Lycaenidae
Morphidae	Hesperiidae

Family PAPILIONIDAE

Aristolochiad papilios, "poison-eaters," velvety black with spots and bars of brilliant red and green, are the commonest forms of this family to be found at Kartabo. They are essentially insects of the jungle, ranging from near the ground upward, but seldom reaching the tree-tops. Occasionally individuals may be found within the clearings, drawn out of their shaded homes into the sunlight by the greater quantity of flowering plants to be found in the open spaces. These butterflies are slow-flying, the wings moving continuously, never sailing with set wings, they are fearless of man, and usually alight in the most conspicuous spots on the tops of leaves. The caterpillars are mottled greens, grays and browns, sometimes marked with white or yellow. A few species as they sit in their usual diurnal position in the center of a leaf, resemble the excrement of birds.

Representing another group of papilios is the southern form of

our northern swallow-tail, or "orange dog," although it is by no means common. It is a swift and powerful flier, always found in clearings, and never within the jungle.

The family, as a whole, ranks among the common insects to be found within the research area.

Family PIERIDAE

This family is rather well represented, especially in forms frequenting the clearings. At certain times of the year, large migrations of male butterflies of the genus *Catopsilia* occur at Kartabo and many other places in British Guiana. These migrations are practically always to the northwest of Kartabo, and sometimes continue for days, the number of insects taking part mounting into hundreds of thousands. Occasionally, for a short time, the direction of the migration may be reversed.

These butterflies are capable of long sustained flights, usually flying when on migrations from two to six feet from the ground, following closely the contour of the country, over rivers, through clearings and, when the jungle is reached, flying straight across the top, and continuing onward over the roof of the forest.

The larger pierids,—yellows, oranges and whites, in appearance and habits much like our northern cabbage butterflies,—inhabit the open clearings. One or two species of this group have adopted the colors of some of the jungle butterflies and have left their clearing homes for the shaded jungle. Instead of possessing broad wings and the usual self colors of the pierids, these butterflies (*Dismorphia*) have long narrow wings, white, bordered and barred with dark greenish brown above, and with a broken brilliant orange band on the lower surfaces of the hind wings. In these forest forms, the flight has also changed, and has become slower, simulating the flight of the species they most closely resemble, especially the danaid *Aeria*.

Family DANAIDAE

The southern form of the monarch is occasionally found in the research area at Kartabo, but it is by no means common. It inhabits clearings, and caterpillars have been found feeding upon *Costus spicatus*.

Ithomiids are the butterflies most typical of the forest about the research station. The greater number of forms are bright yellow and brown, with black bars and patterns; some have opaque wings and others are quite transparent. Their flight is slow, the wings

moving continually, gently and softly. These are found in low and mid-jungle, seldom ascending to the tree-tops or upper portions of the jungle. Small glades and trails within the forest are their favorite spots, where they flit slowly about, their brilliant colors flashing forth as the sunlight falls upon them. Many of these butterflies have social sleeping habits, numerous individuals assembling each evening on one or two bushes, and spending the night close together. Other species have peculiar dancing habits.

These, as we have demonstrated again and again, are distasteful to monkeys, lizards and most birds, and as they are more numerous in individuals, they have served as models for many more edible, but less abundant, butterflies, So close is the resemblance, down to most minute details, that in many cases it requires careful examination with a hand lens to distinguish between them.

Family SATYRIDAE

Satyrs and wood-nymphs are common, many species being found, living entirely within low jungle and near the jungle floor. All are dull browns and grays and blues, while in a few species the wings are wholly transparent. Almost all are characterized by the possession of bright-colored ocelli on the hind wings. The transparent species never alight anywhere but near the ground, immediately vanishing from sight.

Family BRASSOLIDAE

Equally as common as the Morphos are the insects belonging to this family. The most abundant forms are owl butterflies (*Caligo*) with dull purplish upper surfaces of the wings, and mottled gray, white and brown under surfaces, ornamented with a large bluish ocellus on each hind wing. These butterflies are crepuscular and delight in flying up and down trails within the jungle, and along the edges of clearings. Caterpillars are often found, and are especially common on the long leaves of banana.

A number of other species are found within the research area, always in the jungle, and possessing sombre shades of brown and buff above, occasionally with brilliant patches or bands of bright blue, yellow or purple. The undersides of the wings are covered with intricate patterns of grays and whites and browns.

Family MORPHIDAE

The most brilliantly colored butterflies are the Morphos. Dur-

Fig 10 A sleeping Danaid butterfly *Melinaea mneme* Linn
Photograph by William Beebe

ing the beginning of the rainy seasons *Morpho menelaus* is especially abundant. These magnificent insects may be seen flying through the jungle, preferring trails and glades and especially open spaces above streams, and occasionally entering the clearings. During flight the wings move slowly, the insect progressing in undulating waves, the crest of each wave from six to fifteen feet beyond the preceding. This species is seldom seen above mid-jungle.

Occasionally, high in the air, over the tree-tops, may be seen the brown and yellow females of *Morpho hecuba*. Unlike the more brilliantly colored species these seldom descend to the ground or low jungle, but remain in and above the tree-tops.

Three broods of morpho caterpillars have been found. All were found in daylight, congregated on the upper surfaces of leaves suspended over the waters of the river. All the caterpillars were brilliant scarlet, with pale green saddles and cross-patterns, and extremely conspicuous.

Family HELICONIDAE

This essentially neotropical group is quite well represented at Kartabo. Like the ithomiids, which they closely resemble in form and often in pattern and color, they are insects of the jungle, seldom entering clearings, preferring trails and shaded glades. One species resembles the common yellow, brown and black ithomiid, forming with a similarly colored but rare danaid, a mimicry ring. The forms most common within the research area are black, with red cross-bars on the wings, or irregularly marked and spotted with yellow, blue and red. A very small, yellow-brown heliconid, belonging to the genus *Eueides*, is very often found along the edge of the clearing, resembling a common nymphalid, *Colaenis*, in form and color, but distinctly smaller in size.

Family NYMPHALIDAE

Many of the tree-top forms belong to this group, and they are also found distributed through the jungle. Their colors and forms are varied and no generalizations can be made as to their appearance. Some of the commoner forms are among the most beautiful insects to be found at Kartabo, such as *Ageronia*, the Calico, with its indescribable mottling of grays, blues and browns, or *Nessaea*, brilliant green beneath, and orange, black and shining blue above.

Family RIODINIDAE

Seven species only have been found of this small family, the most abundant and striking being *Helicopis*, a small moth, pale yellow and black, with gold bespangled hind wings drawn out into six pairs of tails.

Family ERYCINIDAE

This group is represented by many species, but a comparatively small number of individuals. Mimicry of other forms is evident, and some of the resemblances, especially among those mimicking satyrids, are quite remarkable. These butterflies are small to medium in size, found entirely within the jungle, especially near trails and in low jungle. In coloration they vary from yellow and dull grays and greens to brilliant orange, barred and mottled with black and white, but on the whole are of bewildering variety of form and color. In alighting the erycinids have one habit in common,—they always rest on the under surfaces of leaves.

Family LYCAENIDAE

This family is only moderately represented by about thirty-five forms at Kartabo within the research area, and is only fairly common in individuals. The hair-streaks and blues that are to be found, are confined to the jungle and to the edge of the denser thickets, and are most easily captured as they fly near trails.

Family HESPERIDAE

The Skippers form one of the most abundant families to be found within the research area. They are especially common within the clearing and along the edge of the jungle. Their color is usually brown, with spots of white or buff, or bold splashes of yellow.

Within the clearing, the most common form is a small mottled gray and white species of *Hesperia*. It is always present and seldom flies more than three feet above the ground. This skipper, unlike most of the other representatives of its group, flies rather slowly, the wings moving continually as the butterfly threads its way among the twigs and branches of the smaller bushes near the ground. When alighting the wings are held half way between vertically and horizontally, and after one or two soft wavings, their position changes to vertical, and the upper surfaces face and touch each other.

A number of hesperid caterpillars have been found feeding upon the leaves of the giant bamboos about the station.

Order XIX—COLEOPTERA

About forty families of beetles have been recognized in the quarter square mile under observation.

No detailed classification has yet been attempted and the number of families will undoubtedly be greatly increased when this is done. The number of species of beetles far exceeds that of any other group of insects. A conservative estimate of the coleopterous fauna of the quarter square mile, based on a composite of the number suggested by several entomologists, is ten thousand, of which over half would be divided between the three families of Chrysomelidae, Staphylinidae and Rhyncophidae, the flower beetles, rove beetles and weevils.

The food content of many hundreds of birds' stomachs gives a similar indication of the great abundance of beetles, as more than one hundred and thirty species of birds have been found feeding on

them, Hymenoptera being second, having entered into the diet of ninety-five species.

Yet as far as individuals goes there is no comparison with ants, wasps, termites or flies, all of which infinitely outnumber the beetles. But in number of species the latter far excel the other families.

Family PASSALIDAE

These big, black, slow-moving beetles are the commonest inhabitants of dead logs. At least half a dozen species have been taken without any special search. They would well repay careful study, because of their interesting social and family life, the adults and larvae living together and communicating by audible squeaks.

Family SCARABAEIDAE

This is one of the most interesting and numerous families. Especially the Coprides, which come in numbers to carrion, in bewildering variety. They range from the tiniest of tumble-bugs to giant purple and glowing copper scarabs. Thirty-five species came within a few days to carrion which we exposed. The other tribes of this family, including the cockchafers, so-called June bugs and cetonids are all found in abundance. The latter especially can be collected in numbers about recently felled trees.

Family CICINDELIDAE

Tiger-beetles are not very abundant, apparently not being well adapted to life in the dark humid jungle. In the clearings, however, they are found, and scores of "doodle-bugs" make their tunnels in the compound of the laboratory.

Family CARABIDAE

Ground beetles are not nearly as abundant as in the north. The most abundant is a good-sized black species with large jaws, common in pits and eaten by Bufos. In the compound big yellow and black bombardier beetles are abundant at certain seasons, shooting out a spray over one's fingers which in odor and stain is exactly like iodine. On the sand of the beach tiny nocturnal carabids mimic young mole crickets in arenaceous coloring and in their palmate fossorial front tarsi. Under bark is a favorite place for many carabids.

Family HALIPLIDAE

Minute, rather slow-swimming beetles, quite common in pits and artificial water-holes.

Family DYTISCIDAE

Abundant both in species and individuals. A dozen species were taken in a small tub of water sunk in the jungle.

Family GYRINIDAE

Much more common in the river than in the jungle creeks or pools. When not gyrating some species spend the heat of the day in pairs on the shady side of stakes well above the water.

Family HYDROPHILIDAE

Found both in the river and in the jungle, but less common than the dytiscids.

Family PSELAPHIDAE

Three species of these small interesting beetles have been taken in the nests of termites.

Family STAPHYLINIDAE

Rove beetles form one of the three dominant families of coleoptera, at least in point of numbers of species and individuals. They are found under every condition where coleoptera live, especially on decaying animal matter, fungi and under fermenting bark. They show extreme adaptation to the various environments in color, size and shape, and offer an almost untouched field to the neotropical coleopterist.

Family HISTERIDAE

Although always with the rounded, shining black characters of the family, these beetles differ widely in habitat and the mere glimpses I have had of their larvae show that the diversity in appearance and habits is very great. Carrion, fungi and rotten fruit attract the greatest numbers.

Family SILVANIDAE

These come to lights and several times have been found under bark.

Family EROTYLIDAE

Fungi appears to be the almost exclusive haunt of these ornate beetles, where they are found in numbers, varying widely as to size but usually of a red color.

Family COCCINELLIDAE

Lady-birds, like some other tropical creatures, far transcend

our northern species in brilliance of pattern and coloring, but almost all are small.

Family DERMESTIDAE

Various species quite unlike our northern pests are found infesting our insect collections if not carefully watched.

Family BYRRHIDAE

A remarkable assemblage of small beetles whose antennae, head and legs fit so perfectly into grooves that they appear to be merely lines etched on a curved, perfectly smooth surface.

Family PTINIDAE

Small beetles occasionally coming to light; these have been found in dry bark.

Family LAMPYRIDAE

Fireflies are abundant in species and individuals at certain seasons, and glow worms are occasionally found. There is great variety in intensity and in color of the light. Still more numerous are beetles (*Telephorides*) similar to our soldier beetles of the north, and large black and yellow wide-elytraed *Lycides*. These latter are often very abundant about recently felled trees.

Family CLERIDAE

Small, brightly ornamented beetles, seldom seen.

Family ELATERIDAE

One of the dominant families in size and numbers. On a recently fallen tree many species can be taken as they zoom past, looking for a place suitable for their eggs. The giant lightning bugs which illumine the jungle are click beetles. In a new camping place a flash-light or lantern will often draw fifteen or twenty, which come streaking like meteors through the trees.

Family BUPRESTIDAE

The two first sentences under Elateridae apply with equal force to these insects. They are the wasps of the beetle world, nervous, quick, wary and of brilliant color and pattern. They fly swiftly to dead tree-trunks and run with equal facility over the bark. The largest of all the Kartabo beetles,—the "sun-bee" of the

natives and "chee-ree-gib-bee-puh" of the Akawai Indians is a monster iridescentally metallic buprestid, three inches long.

Family TENEBRIONIDAE

A very large and diversified family, living chiefly in dead wood and fungi. A large black species inhabits the roof of the laboratory.

Family CISTELIDAE

Fewer in numbers than the preceding, but resembling it in general appearance and habits.

Family MORDELLIDAE

Common at certain seasons, resting on the leaves of low bushes in clearings. Brilliant in coloring and equally efficient in leaping, running and flying.

Family RHIPIPHORIDAE

Medium-sized beetles with narrow elytra, plumose antennae, and variegated patterns, on flowers and leaves.

Family CANTHORIDAE

No adults have been taken, but the larvae have been occasionally found attached to bees.

Family BRUCHIDAE

A great variety of beetles come under this family, some large and tenebrionid-like, others small, with marvellous patterns, resembling some of the active bark weevils.

Family CHRYSOMELIDAE

The number and variety of these flower beetles is unbelievable. Only a comparatively few species are taken in numbers, while many of the forms are uniques, seen only once during five years of collecting. The dominant characters are smallness of size, the marvellous colorings and patterns, and a universal habit of death-feigning when alarmed. The variety of situations in which they are found suggests a corresponding diversity of habits and conditions of development. Most of those living under bark are lichen- and wood-hued and of paper flatness, while those on leaves may be extremely convex and glowing like living gems. Most creatures refuse them as food, but cuckoos, toads and organisms with a corresponding catholicity of taste devour them greedily.

Family CERAMBYCIDAE

The tropics are famous for their wonderful longicorns, and Kartabo sustains this reputation. While well to the fore in numbers, this family probably excels in diversity of form and pattern. Some are tiny, with a negligible, almost thread-like body, larger ones have the elytra covered with hieroglyphics which appear almost decipherable; others have immense tufts of parti-colored hairs on the antennae or the hind legs, while the giant long-legged *Acrocercus* is in a class by itself.

In mimicry alone this family is supreme, and I occasionally take forms which in shape, size, color, pattern and, most astonishing of all in action, are perfect imitations of bees and wasps.

By far the commonest, and almost the only form which ever comes to light, is the green and yellow *Chlorida festira.*

A coleopterist could spend a life-time at Kartabo, studying this family alone, and have but little time hanging heavily on his hands.

Family ANTHRIBIDAE

Fairly common, but difficult to define and no definite notes have been made upon their haunts or habits.

Family CURCULIONIDAE

One of the three dominant families, if not actually in first place itself in point of species. Weevils are not conspicuous to the casual walker through the jungle, but in week after week of collecting, the weevil boxes are the ones which soon fill to overflowing. Again we find rather an enormous number of species represented by one or a very few individuals, than any great preponderance of beetles themselves. Giant palm weevils and others equally large with inexplicable furry beaks covered with dense auburn hair are at one extreme, while the small wasp-like, active bark beetles represent a wholly different type. Mother-of-pearl weevils which close up and drop to earth at a touch are the most abundant on the leaves of the undergrowth.

Family BRENTHIDAE

These are usually bronzy beetles with enormously elongated thoraxes. The largest species are found under bark, never doing anything as far as my brief observations go. They are slow walkers and do little to avoid capture.

Order XX—STREPSIPTERA

Family STYLOPIDAE

Twice only have we observed a member of this parasitic group imbedded between the segments of the abdomen of a wasp.

Order XXI—DIPTERA

Very large collections of two-winged flies have been assembled, but only a beginning has been made in specific identification. They are present in enormous numbers, but under ordinary circumstances are not conspicuous. On a walk through the jungle, only here and there is a fly seen resting on a leaf or hovering motionless in mid-air. At the laboratory there is almost never a fly on the dining table, and at our work a few midges in early morning during the rainy season are all that interfere. One species of biting fly alone is ever troublesome, and this in extremely small numbers, easily killed, and in the rainy season only. At the most two or three may attempt to bite during a long walk.

But at a bit of decayed meat, or a sudden growth of fungi or oozing sap, hosts of flies will gather at once. Also, several sweeps of a fine-meshed net among the jungle undergrowth will often take hundreds which, in the dim light, were invisible to the eye.

Out of seventy-one families of Diptera in the world, forty-two, or about 60 percent have been already detected in the quarter of a square mile of jungle under observation, and future search should bring the total up at least to sixty families, as that number should reasonably occur, according to geographical distribution.

Family CECIDOMYIIDAE

These minute insects are taken in the sweep net both in clearings and the jungle and their galls are abundant, seen on weeds, bushes and the smaller twigs of trees.

Family MYCETOPHILIDAE

A few have been observed on fungus. Doubtless a careful search would reveal large numbers.

Family CULICIDAE

Many species of mosquitoes are found in the jungle, but only under abnormal and very unusual conditions are they ever troublesome. Ordinarily no nets are ever used in the sleeping tents and

one may sit quietly for hours in the midst of a swamp without hearing a mosquito or being bitten. The unprecedented drought of the spring of 1924 resulted in the formation of large numbers of isolated pools near the rapids of the Cuyuni in which vast numbers of mosquitoes developed before the beginning of the long delayed rains. These spread over the country, became infected by the Indians, and for the first time we all suffered from brief attacks of malaria. Most of the natives have chronic fever but make no attempt to combat it.

Giant, brilliantly colored mosquitoes breed in the bromeliad water, and go piping through the jungle, sounding like young birds calling for food.

Family SIMULIIDAE

"Black flies" are very rare at Kartabo and their place is taken by the following family.

Family CHIRONOMIDAE

The larvae of these midges form an important item in the food of the smaller shore fishes, and the imagos emerge at intervals in countless swarms. These aquatic species confine themselves, however, to the boats and stellings; they do not bite, and seldom fly more than a foot or two above the water or shore.

Tiny black midges are sometimes troublesome for an hour in early morning and late afternoon.

Family PSYCHODIDAE

The tiny moth flies are locally very common. A large species is abundant about out-houses, and a very small grey-haired form has been reared from fungus.

Family DIXIDAE

Inconspicuous flies, rather rare, long-legged and buffy in color, taken in sweep-net in jungle trails.

Family TIPULIDAE

Crane flies of all sizes are common, especially in the dark cavities of hollow stubs, under over-hanging banks and at lights in the evening.

Family BIBIONIDAE

Not rare, the commonest being a large smoky-winged species with red thorax hovering about fallen logs.

Family RHYPHIDAE

Small, mosquito-like flies of this family are occasionally taken in jungle trails.

Family STRATIOMYIDAE

An abundant group, some very large, and many with bizarre shapes and brilliant colors. They are found over water and on the damp bark of trees. Some have a transparent window at the base of the abdomen, giving the appearance of a slender, wasp-like pedicle. A yellow-faced species has a circular body, purple, touched with grey.

Family LEPTIDAE

Medium-sized flies, with marbled or otherwise variegated wings, common in the jungle, chiefly about decayed fruit or rotten wood.

Family TABANIDAE

Abundant in a great variety of places, including some very large species. The yellow, band-winged "deer-fly" is the only fly which ever bites one along the jungle trails. The beautiful pale-green *Tabanus mexicanus* is occasionally found in the laboratory at light, but is seldom seen outdoors.

Family THEREVIDAE

Medium-sized flies, closely resembling small robber flies and with similar habits.

Family BOMBYLIIDAE

Bee flies are not common, but very beautiful, heard and seen hovering in mid-air, often close to the jungle floor. They are so wary that it requires the most careful stalking to capture them.

Family ACROCERIDAE (CYSTIDAE)

The commonest species resembles a good-sized metallic bee, with enormous eyes and a proboscis so long that it extends back twice the length of the entire body.

Family MYDAIDAE

Very large flies resembling asilids, but with slow flight among the undergrowth.

Family ASILIDAE

One of the largest groups of flies and by far the most conspicuous. A dozen species can be seen on a single walk along a jungle trail. They rest on leaves waiting for their prey to come in sight, and return to the same position to devour it. Their diet includes almost all kinds of insects, with flies and bees, and especially trigonid bees, in the majority. Robber flies are of all sizes and colors, some being almost mosquito-like in their delicacy, others closely resembling in size and color and hairiness the largest *Xylocopa* bees, doubtless an authentic case of aggressive mimicry.

Family EMPIDAE

A hundred of these tiny flies may be taken at times in the jungle with a few sweeps of the net, but to the non-Dipterist they form but a slight visible proportion of the life of the jungle.

Family DOLICHOPODIDAE

These come second to the asilids in general visibility. A few steps along any jungle trail is sure to reveal one of these long-legged, iridescent-bodied flies running over the surface of a leaf, or waiting quietly for the small creatures which form its prey. I have never seen them in any other situation.

Family PHORIDAE

Abundant around dead animal matter and in mid-air in trails. Wingless phorids are common on fungi and as guests of army ants.

Family PIPUNCULIDAE

Tiny flies with enormous heads and eyes are captured in sweep-nets in the deep jungle.

Family CONOPIDAE

The commonest species are remarkably perfect mimics of wasps, and the advantage of this is very evident when we know that the females lay their eggs on the bodies of various hymenopters.

Family SYRPHIDAE

Flower flies are relatively less abundant than several other groups, but all are dazzlingly brilliant or decorated with bright yellow. They are chiefly to be found hovering in mid-air in clearings.

Acalyptrate MUSCIDAE

This hodge-podge of flies is represented by a vast number of widely varying forms, some iridescent, others with beautifully marbled wings, while some have legs of enormous length. Many species are found walking about on sap-covered bark laying their eggs in crevices. Drosophilids, as elsewhere, are abundant on over-ripe fruit, and hosts can be taken in a few sweeps of the net in the jungle.

The following are a few of the families which have been distinguished:

Sciomyzidae	Trypetidae
Geomyzidae	Sapromyzidae
Drosophilidae	Ortalidae
Psilidae	Agromyzidae
Tanypezidae	

Family ANTHOMYIIDAE

These are small editions of house flies which are abundant about decaying animal remains.

Family TACHINIDAE

A few of these big, hairy flies have been taken in the jungle, but the majority of the species and individuals have been hatched as parasites from caterpillars and chrysalids of lepidoptera.

Family DEXIIDAE

Several flies, closely resembling Tachinids, conform to the characters belonging to this family.

Family SARCOPHAGIDAE

Very abundant on all decaying animal matter but never coming into the laboratory or tents. This is inexplicable, as thousands may cover a dead animal or bird which has been put out a few yards away, to attract vultures, and yet no member of this family is ever found on our dining or work tables. Some appear exactly like northern house flies, others are large and marked with beautiful patterns.

From the body of a small antbird in a state of advanced decomposition, I took, within a period of fifteen minutes after exposure, twenty-two species and eleven hundred and forty individual flies, the majority of which belonged to this family.

Family OESTRIDAE

The larvae are frequently found under the skin of wild animals, and are sometimes so abundant on nestling birds that they cause death. Imagos, sometimes of very large size, are captured now and then. The largest measured over an inch and a half in length. I, and several members of the staff, have had "mosquito worms" deposited in the shoulder or behind the ear. Our love of science fell short of allowing them to develop!

Family HIPPOBOSCIDAE

These strange flies are not uncommon on certain wild mammals. I have taken forty deälated individuals from a small deer. A large collection of feather flies has been made from birds—the gallinaceous forms almost always having several swimming through and over the plumage.

Family STREBLIDAE

Winged flies of this remarkable family are taken occasionally on bats.

Family NYCTERIBIIDAE

These strangest of flies, wingless and highly specialized for their limited environment, are found only in the fur of bats, and each species of bat appears to have its particular form of nycteribid.

Order XXII—SIPHONOPTERA

Family PULICIDAE

Fleas have been found on a number of wild animals, while "jiggers" are abundant on the sandy floors and yards of Indian benabs.

Order XXIII—HYMENOPTERA

As far as any adequateness of treatment is concerned I might just as well say that ants, wasps and bees are present in vast numbers in the quarter square mile of jungle, and then turn to the next group of organisms.

I have made only the most casual attempts to divide them into families, and no group has as yet been studied completely by any competent Hymenopterist.

Although quite inadequate for any thorough, modern, taxo-

nomic treatment, Sharp's general arrangement of Hymenoptera in the *Cambridge Natural History* has proved satisfactory for my present purpose. So I have constantly adhered to it, merely raising a number of his subfamilies or tribes to the more modern view of families. Out of forty of his families, neotropical in range, I have found about thirty at Kartabo.

Family TENTHREDINIDAE

Saw-flies are not nearly as abundant as they are in the north, while the relatively great abundance of individuals of the species is more like northern organisms than is usual in the tropics. The commonest is a small species which crawls slowly about on the leaves of the jungle, while at times a yellow-bodied form is extremely numerous, flying slowly along close to the jungle floor. The function of this family is most certainly usurped in the research area by some other group.

Family CYNIPIDAE

These little insects and their galls are abundant but no notes have been made upon them.

Family PROCTROTRYPIDAE

Numbers of species of these very minute wasps have been bred from butterfly eggs. The only notes made have been on the number of individuals in each egg, and the sex. From eleven to twenty-five proctrotrypids find nourishment and the wherewithal for growth and development in each lepidopterous egg, and in several dozen carefully observed instances there has never been more than a single male, who fertilizes all of the females as they emerge.

Family CHALCIDIDAE

Found everywhere in bewildering variety, a few of remarkably large size, most beautifully sculptured and patterned, and in color from buff, yellow, red and blue to the most intense iridescence. Over fifty percent of all the lepidopterous caterpillars taken are parasitized with these or closely related forms.

Families ICHNEUMONIDAE, BRACONIDAE

I have bracketed these two families because of the similarity in superficial appearance in the field and the identity of habits of the

more conspicuous forms. On a single long walk I have taken about fifty individuals, which would prove to be about evenly divided between the two families. They are found flying low through the underbrush searching leaf after leaf, both upper and under sides, for the prey which they parasitize. The majority of the larger forms of both families have yellow- and black-banded wings.

Family STEPHANIDAE

A small family of insects resembling the above.

Family EVANIIDAE

Not rare and most remarkable in shape, some appearing as if the abdomen had been amputated, this portion being reduced to a tiny knob protruding from the upper part of the thorax while others have enormously elongated abdomens which are parti-colored and held aloft.

Family PELECINIDAE

A half dozen specimens with greatly elongated abdomens have been taken of these insects.

Family CHRYSIDIDAE

Fairly common insects clad in magnificent reticulated armor of glittering blue-green.

Family MELIPONIDAE

This family is the most characteristic group of Tropical bees. It includes the *Melipona* and *Trigona*, mostly small black or brown insects about 6 mm. long. These are stingless, social bees, usually building mud or waxy nests in logs, in the ground, in odd corners of buildings or even in termite nests. One large colony had apparently experienced considerable difficulty in working over the nest carton and maintaining their entrances against the termites. Both entrances extended several inches beyond the normal circumference of the nest, giving evidence of a long struggle before the termites gave up and allowed the entrances to remain open.

The open mud nests were subject to enlargement by the addition of further hanging galleries until the colony reached its maximum size and swarming occurred. These nests were further characterized by the presence of bee-bread and honey pots, maintained in place by short, strong braces of wax and mud.

A considerable variation in pugnacity was found among the different colonies; the one described above would swarm out angrily and bite viciously if the nest were even jarred by a blow against the tree on which it was located. Other colonies could be examined at close range without apparently disturbing the inhabitants.

Some twenty odd species have already been described from Kartabo.

Family XYLOCOPIDAE

Seven species of these wood borers have been found at Kartabo and vicinity. They usually proved quite wary and were difficult to collect. The higher flowers were their favorite haunts, adding still more to their safety. One species reached a length of 35 mm., the females being black and the males mostly brown. In several other species, both sexes were black with hairy, ferruginous thorax.

Family CERATINIDAE

Few individuals of this family of carpenter bees were noted at Kartabo. Possibly three species. They are very small in comparison to the other family of borers, the Xylocopidae.

Family BOMBIDAE

In number of species, this family was poorly represented, only two having been described as yet. Even these species are open to question, it being possible that they are identical. The individuals are very numerous, however, and can be collected from any plant or shrub along trail or road, in cleared ground or on river banks. They are dull, slow of flight, and easily captured.

Family AUGOCHLORIDAE

About seven species of these little iridescent bees of the genus *Halictus* and the genus *Augochlora* have been noted. They are true tunnel makers, preferring the soft earth of the side of a pit or bank for their homes. Although they may use a common gallery into the earth, each bee has its own branch, this family being truly solitary.

Family ANTHOPHORIDAE

Seven species of *Centris* of the subfamily Centrinae are plentifully represented in the Kartabo region. Possibly the most numer-

ous species were large brown bees, invariably found around rivers. They seemed to enjoy basking in the sunshine on logs or planks; whirling in erratic flight about a passing boat or canoe; or investigating, with much interest, the paddler's hat or perhaps even his insect net. Their white-marked faces gave an odd impression of intelligence, well borne out by their elusiveness when pursued and their delight in taunting the pursuer by whirling past him with terrific speed.

Two species of *Melitoma*, also belonging to this family, were found.

Family MEGACHILIDAE

Four species of *Megachile* and at least one of *Coelioxys* have already been described. Those of the genus *Megachile* are the true leaf cutters and build nests or burrows lined with sections cut from leaves.

Family EUGLOSSIDAE

This family of long tongued bees is without doubt the most striking family found around Kartabo. Possibly fifteen species or more have been collected. Brilliant reds, greens and blues, combined with yellow and black, solid greens and solid blues and purples, present an assortment of color that cannot be rivaled. They possess an extremely rapid wing beat, enabling them to maintain themselves stationary in the air, while collecting their food from flowers. They are solitary, building in the ground or even in termite nests.

Including other unclassified specimens with the groups considered above, one is justified in believing that from one hundred to one hundred and twenty species of bees have already been collected from the Kartabo region. Those listed above are the most common families, others occurring rarely.

Family EUMENIDAE

The small potter wasps are not nearly as abundant as a northern hymenopterist would expect them to be. Several species build their nests in the laboratory.

Family VESPIDAE

This is the largest family of wasps and hornets, or marabuntas,

as the natives call them. Their nests, large and small, are seen along the trails and in the deep jungle, near the ground and in the tree-tops.

Family MUTILLIDAE

The wingless, velvet wasps are present in numbers and there is an abundance of species. The wingless females are more often seen than their mates, and are gay with spots of gold and scarlet.

Family SCOLIIDAE

A widely varying and numerous group, some big, yellow and hairy, others small and iridescent green. I have found two of the extremes of size parasitizing larvae of Scarabaeidae, so it is reasonable to suppose that many intermediate types have the same habits.

Family SAPYGIDAE

Only a few of these have been collected, closely resembling members of the preceding family.

Family POMPILIDAE (PSAMMOCHARIDAE)

Very numerous, many of large size with black or orange wings, others grey, with banded wings. Some are very tiny and stick their mud cells to the beams of the laboratory. They tirelessly hunt dead and living leaves, trunks and twigs for their spider prey.

Family SPHEGIDAE

These strong mud-daubers are abundant, and certain of their number are among the largest of Kartabo hymenoptera, one specimen reaching an extreme length of two and one-half inches, and with a sting which would surely send a human victim to bed with a week of fever.

Family LARRIDAE

Moderate to large wasps, most of which nest in the jungle floor, while others build beautiful nests of plant-down on the under sides of leaves. Their colors are greatly varied, and they are only fairly abundant.

Family TRYPOXILONIDAE

The most familiar families of wasps at the laboratory are little black fellows which we call vial wasps, from their habit of seizing

upon every empty horizontal vial they can find, to divide it into little cells and stock with spiders. The group is small and only occasionally is one taken in the jungle.

Family BEMBECIDAE

These wasps have the untropical character of being only fairly numerous as to species with exceedingly abundant individuals. Every area of sunny sand in a jungle trail or clearing is sure to have dozens buzzing about or digging frantically, throwing up little spurts of sand as they sink from view. Persons new to the jungle have to be assured that, although these big, yellow wasps love to buzz alarmingly close to one's face, they are never known to sting without strong provocation.

Family NYSSONIDAE

A small family with a few species, resembling the preceding in many characters.

Families PHILANTHIDAE, CRABRONIDAE

Two unimportant Kartabo families of small, yellow-banded wasps, more abundant during the dry than the rainy seasons. Their habits vary widely and I have found them nesting both in the ground and in hollow twigs.

Family FORMICIDAE

One's first walk through the jungle, as well as the last day of many years' residence, results in the same conclusion, that ants by far outnumber all other groups of insects. But not until Prof. William Morton Wheeler had spent several months collecting them, did I realize the great number of species represented in our quarter square mile. Even in the much more restricted area of the laboratory compound, he found every genus of fungus-making ant known in the world, and on a single tree only one hundred and fifty feet away from the laboratory, Prof. Wheeler collected ninety-six species of these insects.

The abundance and remarkable habits of the army ants *Eciton*, and leaf-cutting ants, *Atta*, have led me to write several essays about them.[3] But scores of others are equally interesting and would repay

[3] Jungle Peace, Chapter IX, Edge of the Jungle, Chapters III, VII, VIII.

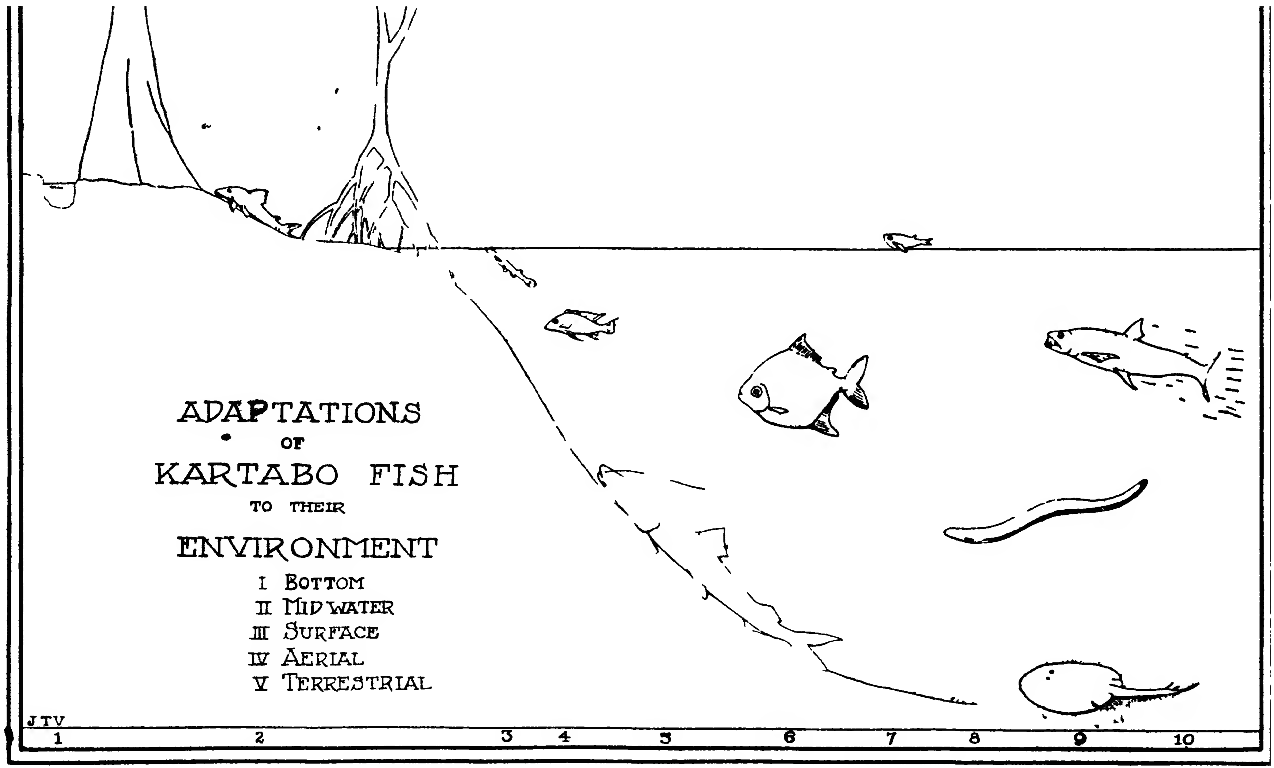

Fig 11 Adaptions of Kartabo fish to their environment
Drawing by John Tee-Van

months of study. The most conspicuous ant in the deep jungle is *Ectatomma tuberculatum*, which waits, solitary and patiently, on leaves for the approach of victims. Up and down the trunks travel the giant black *Neoponera* ants, the pain and swelling of whose sting last for many days. One fact, from the host which comes to the eye of the casual observer, is the specialized diet of some of these Ponerine ants, one of which feeds solely upon giant termites of the genus *Syntermes*.

Several times a year army ants clear our laboratory of all roaches and tarantulas, while, on the other hand, leaf-cutters render hopeless all our attempts at gardening—destroying both flowers and vegetables. Tiny red ants make it necessary to keep all fresh specimens on swinging shelves, but aside from this no ant disturbs or injures our possessions.

CHORDATA OR VERTEBRATES

Within the small area set aside at the Tropical Research Station at Kartabo for intensive study, I have recorded eight hundred and eighteen species of vertebrates, almost exactly 60 per cent. of the total number so far known from the whole Colony of British Guiana. This may be taken as showing either the wide distribution of vertebrate forms of life and their abundance in a small area in the tropics, or it may indicate the very great number of species still to be discovered when intensive investigation similar to mine in my quarter of a square mile, is applied more widely. The truth lies probably between the two.

As the area under consideration is only one-three hundred and sixty thousandth (1–360,000th) of British Guiana, this record is rather remarkable. It is as if there were found within half the area of the New York Zoological Park, or one quarter of Central Park, New York City, more than half of all the vertebrate animals of New York and Pennsylvania combined.

Among the invertebrates, the insects, and more especially ants, are by far the dominant forms; with vertebrates, birds are ahead to such an extent that there is relatively no second place. This is distinctly shown in the following table, together with other side-lights upon the general aspect of the back-boned animals of this limited area.

Vertebrate Classes	No. of Species	Percentage of Whole	Number Individuals	Dominant Visually	Dominant Vocally	Dominant in Color	Extremes in Size	Danger to Man
Fish	150	18 6%	1	5	5	3	2	2
Amphibians	37	4 5%	2	3	2	4	5	5
Reptiles	93	11.4%	4	2	4	2	3	1
Birds	464	56 5%	3	1	1	1	4	4
Mammals	73	9 %	5	5	3	5	1	3

THE FISH OF KARTABO

The study of the fish life in the research area at Kartabo has been made doubly delightful by constant reference to Dr. Carl H. Eigenmann's "Fresh-water Fishes of British Guiana." An additional source of interest lies in the fact that the Station is situated at the junction of the only two great rivers in the Colony which Eigenmann did not explore, so that every capture or note which we make is certain to contribute a wholly new fact to our knowledge at least of the distribution of forms.

Within the few hundred yards included in the shallow water along the shore of our research area, and in one or two adjacent creeks, we have secured one hundred and fifty species of fish, rather more than one-third of the entire number secured by Dr. Eigenmann in his exploration of the Colony at large.

While the low mentality of fish is undoubtedly a fact, yet this is compensated by the interest of their great diversity of form and size, marvellous beauty and remarkable habits, and perhaps most of all by their vital suggestions of past evolution and the vivid evidence of evolution going on today, which they express in their bodies and their life habits.

As in the jungle, so the tropical waters teem with unexpected and strange organisms, and there is no level or niche left unexplored or unoccupied by one or more species of fish. I shall mention only a few of the many interesting aspects of fish life about the Station. In extremes of size we find schools of little sword-finned minnows close inshore, measuring less than an inch in length, while farther out, great lau-lau catfish swim about, brobdignagian bull-heads six to twelve feet in length, with grinning mouths two feet wide. They

will occasionally take the hook but put up no more fight than would a barrel of cement. The largest fresh-water fish in the world and one of the most gamey also inhabits Guiana waters, the arapaima, which reaches a length of fifteen feet and a weight of over four hundred pounds. We have, however, not yet taken it at the Research Station. The flesh of all these fish is most delicate.

Many of the fish are very beautiful, but on the whole there is hardly an average of greater brilliancy of pigment than in the fishes of temperate waters. Scarlet eels and golden catfish with fins of flame-color are astonishing when they swim up through the brown water; and many-colored ocelli or eyed spots are rather common both on fins and bodies. As to variety of form there is no end. To take mouths alone, there is the elongated tube of the pipefish, the swordfish-like needlefish and the halfbeak with its minute upper mandible and enormously lengthened under jaw. Most frightful looking fish come up in the seine, such as the silvery biara or dog-toothed fish, with teeth so long that they pass clear through the head and project into the water above, yet which is a fish wholly innocuous; on the other hand a meek appearing sunfish is in reality the notorious perai, one of the most dangerous of all fishes. Nothing more hopeless can be imagined than to be attacked by a school of these razor-toothed little fiends.

The sand gobies, when frightened, flatten out on the bottom, and draw over themselves a mantle of color identical with that of their background: the comical green- and black-banded puffers, on the contrary, distend themselves with air into a taut, skinny, inedible ball, and float out of reach upon the surface until danger is past.

The fish about Kartabo show three important radiations; first, intrusions from the salt water of the open sea, fifty miles away by water line; second, aerial attempts, and third, terrestrial trials. As unexpected intrusions from the sea we find the gobies and the young gar or needlefish is also essentially marine. Most remarkable are the sting rays, two species of which have deserted salt water and inhabit our rivers. The last ocellated ray which we caught on a set line, gave birth to five young rays in the boat; in an aquarium the little rays flapped slowly about on the sandy bottom and the back of the mother.

The four-eyed fish is also essentially a lover of salt or brackish water but occasionally it enters the fresh waters about Kartabo. It is, however, as an invader of the air that it holds greatest interest,

the upper part of the eyes being modified for atmospheric vision, while it appears unable to dive more than a foot or two beneath the surface. The second aerial aspirant is the fresh-water flying fish, built rather on the lines and method of operation of a hydroplane than an airplane, as it rises with a rush and slithers along the surface, its deep keel usually cutting a tiny furrow as it goes.

The piscine land invaders are of extreme interest, both on account of their individual specializations and their evolutionary significance. When a pool forms after a heavy rain, deep within the jungle, or on a hillside well away from water, it soon contains fish as well as tadpoles and whirligig beetles; fish not descended with the rains, as the old legend has it, but which have scrambled and leaped and finned their way from the abundance of their element in the great rivers to this meagre, temporary cupful of water in the midst of a host of terrestrial dangers. Why the impulse comes to them, or to them and not to many others, we cannot even imagine.

Other land-loving fish are the primitive hassas or armored catfish, which come out at low tide and flip about the mud, regardless of sun or drought. These and the marsh eels are most unsatisfactory aquarium fish, for they are continually climbing out and seeking the seclusion of dusty corners. I may here only mention the astounding electric eel with its double dynamos of living flesh, and the nurse fish, whose young find sanctuary by the half hundred in the mouths of their parents.

While there is no lack of fish, large and small, near the Station, yet the least successful method of capture is by rod and line. This is due to several reasons, chief among which is the low visibility of the brown jungle water, combined with the abundance of natural food which the fish find ready at hand. Fish hold an important place in the diet of the Indians about Kartabo and they are skilful in shooting them with bow and arrow, poisoning and trapping them. They know the exact edibility of the various species and of the poisonous parts of specific ones such as the liver of the large catfish. They have names for almost all and even distinguish between forms which bear a very close superficial resemblance.

Our collections have been made almost altogether by means of set lines and seining.

Within the research area I have a record of forty-seven species of vertebrates feeding on fish, of which about half probably devour no other forms of life. If several more thousands of stomachs could

be examined this number would be considerably increased, especially among the fishes themselves. These enemies of fish vary from creatures like the snakebird, kingfisher and dolphin which seem fundamentally adapted for a piscine diet, to the kiskadee flycatcher which has only recently taken to fishing.

The piscivorous vertebrates of Kartabo are as follows:

Fish	12	Birds	26
Amphibia	1	Mammals	3
Reptiles	5		

The remarkably general distribution among varied orders of vertebrates is well indicated in the following list:

Class PISCES

Order	Genera
Batoidea	*Potamotrygon*
Nematognathi	*Paulicea*
	Brachyplatystoma (3 sp.)
	Ageniosus
Heterognathi	*Serrasalmo*
	Hydrolicus
	Cynopotamus
	Hydrocynus
Symbranchii	*Symbranchus*
Percomorphi	*Plagioscion*

Class AMPHIBIA

Cystignathidae	*Leptodactylus*

Class REPTILIA

Boidae	*Eunectes*
Ilysiidae	*Ilysia*
Colubridae	*Hydrops*
Elapidae	*Micrurus*
Crocodilidae	*Caiman*

Class AVES

Ralliformes	*Heliornis*
Lariformes	*Phaetusa*
	Sterna (2)
	Rhynchops

Gruiformes	*Mycteria*
Ardeiformes	Herons (11)
Pelicaniformes	*Phalacrocorax*
	Anhinga
Accipitriformes	*Pandion*
Coraciiformes	Kingfishers (5)
Passeriformes	*Pitangus*

Class MAMMALIA

Marsupialia	*Chironectes*
Carnivora	*Lutra*
Odontoceti	*Inia*

Class PISCES

Order BATOIDEA

Family PRISTIDAE

Sawfish Rays: There are four records of sawfishes caught at Kartabo before our first arrival, and twice during our absence twelve-inch individuals have been secured by Indians in creeks. This is distinctly a marine intrusion, with the precedent of what is probably the same species ascending the Mississippi for a considerable distance.

Family DASYATIDAE

Sting Rays: Strictly marine rays are found abundantly in the lower Essequibo, but from Bartica up, two species of fresh-water rays occur, one rather commonly. Five miles higher, above the rapids and from there for many miles up river these are numerous and a constant source of danger to gold and diamond seekers. The mucous of these fresh-water forms seems more virulent than that of the sea rays. Both species have been taken at Kartabo, and the young to the number of five been born alive in captivity. They are carnivorous bottom feeders, taking worms, small fish, shrimps and drowned organisms.

Order NEMATOGNATHI

Fresh-water catfish are especially characteristic of the Amazon and Guiana regions. Thirty-four species have been found at the Station, divisible into five families.

Family SILURIDAE

Twenty species belong under this family. Among them are the common bottom or mid-water forms, one of which, a *Pimelodus* locally known as Larima is actually abundant. These are of small or moderate size, but in this same genus are the giants of these waters, such as *Brachyplatystoma,* the lau-lau, which ranges from a length of not uncommonly seven feet, to reputed giants of twelve feet.

The smaller catfish are mostly bottom feeders and embrace in their diet worms, small fish, mollusks, shrimps and hosts of drowned terrestrial insects. The giant mid-water forms feed altogether on medium-sized fish, and spend most of their time well out from shore where they can be caught on strong set lines at night. Occasionally however they come close in and can be heard grunting and booming among the rocks and mangroves.

Family HELOGENIDAE

A single, small, mottled catfish of this family is occasionally taken in jungle creeks.

Family PYGIDIIDAE

Two species, one quite eel-like in shape, also occur in creeks.

Family CALLICHTHYIDAE

Three species of these interesting armoured catfish occur, all feeding on muddy vegetable debris.

Family LORICARIIDAE

Seven species of this family show two general types of structure, one of which, *Loricaria,* is exceedingly flattened for a strictly bottom life, while *Plecostomus* is triangular in transverse section and is almost as much at home on the mud of the shore as in the water. All feed on vegetable debris and small organisms. *Plecostomus* is eaten by the small river cormorants.

Order HETEROGNATHI

Family CHARACIDAE

In number of forms and variety of types the Characins of Kartabo may be compared with the Passerine group of birds. We have collected fifty-one species, comprising nearly forty per cent of the entire fish fauna. These are distributed through seventeen families.

Many are very small and inconspicuous looking fish, and among them are the most abundant shore forms. None are true bottom livers but are found in mid-water and on the surface, chiefly in creeks or along the shore. A few are brilliantly colored. Several have enormously developed canine teeth and are aquatic wolves; the notorious Perai has moderate teeth but is the most dangerous, fiercest fish here, if not in the world. Its closest relative is a harmless vegetarian. The fresh-water flying fish are Characins, skimming for long distances along the surface. A few of the larger species form the chief food of the Indians. Worms, insects, shrimp and other fish form the principal items of diet of these fish.

Order GLANENCHELI

Family GYMNOTIDAE

The eels of Kartabo number eight species distributed unequally among four subfamilies. All are interesting forms but the electric eel is preeminent, and specimens over five feet in length have been taken. We have occasionally had a shock transmitted by the water when swimming but any danger is imaginary. It feeds on shrimp, tadpoles, fish and other small organisms and except when small is found in the open river. The other eels are inhabitants chiefly of jungle creeks and several are brilliantly colored. They feed on shrimp, caddis-worms and insects.

Order SYMBRANCHI

Family SYMBRANCHIDAE

This eel in appearance and habits resembles so closely the limbless amphibian *Typhlonectes* that we considered it as such for a long time. It lives in swamps and in the mud along shore, and forms the chief food of coral snakes and of two of their mimics. It feeds in turn on fish and crabs.

Order ISOSPONDYLI

Family ENGRAULIDAE

Two small species of *Stolephorus* are found along the shore, one very abundantly. They are small, silvery fishes with such delicate, deciduous scales that the least touch dislodges a shower. A species of *Lycengraulis* is considerably larger than the two preceding. The food is minute insects and entomostracans.

Order MICROCYPRINI

Family POECILIDAE

Five interesting small fish represent this minnow-like family. *Rivulus* is the most terrestrial of all the Kartabo fish fauna, and is found in isolated rain pools deep in the jungle, a half mile or more away from the river. *Anableps* is essentially a salt-water form, the Four-eye adapted equally well to see under water as well as in the air. Three small ones among the mangroves are all we have on record at the Station.

The Sword-finned Minnow, *Tomeurus*, is a very abundant and persistently littoral form, with the male showing most remarkably specialized sexual characters. Entomostracans form their principal food.

Order SYNENTOGNATHI

Family BELONIDAE

A small gar-like fish is very rare at Kartabo.

Family HEMIRHAMPHIDAE

A curious fish, with enormously elongated under jaw, and a short stump of an upper jaw, lives along the shore and feeds on spiders, gnats and small mollusks.

Family ESOCIDAE

There is one record of a *Tylosaurus*.

Order LOPHOBRANCHII

Family SYNGNATHIDAE

A small pipe-fish is not uncommon. All the specimens secured have been females with the ventral brood pouch filled with eggs more or less advanced in development.

Order PERCOMORPHI

Family CICHLIDAE

An interesting family of which seven species are present. *Geophagus* is common along shore, the parents sheltering the young fish in their mouths in time of danger. *Crenicichla*, a very brightly colored carnivorous form, lives in mid-water.

Family SCIAENIDAE

Three species, one of which, *Plagioscion*, is very common and an important food-fish.

Family POLYCENTRIDAE

One small, vertically flat, black, changeable colored fish of the deep jungle is occasionally found.

Family GOBIIDAE

Three very common forms of sand gobies. One, an *Eleotris* with most remarkable color changes, spends much time in the open air or in small tide-pools. Two sand gobies are found intensively associated, resembling each other in size, shape, general sandy pattern, carnivorous habit, yet belonging to very distinct genera—*Evorthodus* and *Awous*.

Order HETEROSOMATA

Family PLEURONECTIDAE

A small species of flounder is rare and very local in distribution. Native fishermen say that it was first found here four years ago, so is evidently a recent invasion. Nothing has been found in its stomach but sponge spicules and Chironomid larvae.

Family SOLEIDAE

Two species, of which one, a small flounder of the genus *Achirus*, is somewhat more common than the other, all the specimens being under three inches in length.

Order PLECTOGNATHI

Family TETRADONTIDAE

A small, green- and black-banded puffer is common along shore. It also occurs as a surface feeder out in the open river and is especially numerous at the mouths of jungle creeks. It is an omnivorous feeder, and is fed upon by *Ardea cocoi*.

FISH STOMACH CONTENTS

Sponge Spicules—	*Pimelodus clarias*
	Achirus fasciatus
Worms—	*Potamotrygon hystrix*
	Leporinus arcus
	Poecilurichthys abramoides
	Gymnotus carapo
Oligochaetes—	*Hemidoras carinatus*
	Leporinus nigrotaeniatus
	Pristella riddlei
	Gymnotus carapo
	Eigenmannia virescens
	Gymnorhamphichthys hypostomus

Fish stomach contents—continued

Leeches—	*Stolephorus surinamensis*
Mollusks—	*Pimelodus clarias*
	Megalodoras sp.
	Hyporhampus roberti
	Colomesus psittacus
Entomostracans—	*Stolephorus surinamensis*
Daphnia—	*Stolephorus surinamensis*
	Tomeurus gracilis
Cyclops—	*Hemidoras carinatus*
	Stolephorus surinamensis
Isopods—	*Sternopygus macrurus*
Shrimps—	*Potamotrygon hystrix*
	Pimelodus clarias
	Pimelodus ornatus
	Chalcinus rotundatus
	Hydrolicus scomberoides
	Electrophorus electricus
	Gymnorhamphichthys hypostomus
	Stolephorus surinamensis
	Plagioscion auratus
	Crenicichla alta
Crabs—	*Pimelodus clarias*
	Symbranchus marmoratus
Crustaceans—	*Pimelodus clarias*
	Pimelodus ornatus
	Leporinus alternus
	Poecilurichthys abramoides
	Stolephorus surinamensis
	Tomeurus gracilis
	Colomesus psittacus
Chelifera—	*Pimelodus clarias*
	Hemidoras carinatus
Spiders—	*Leporinus alternus*
	Chalcinus rotundatus
	Tomeurus gracilis
	Hyporhampus roberti
	Colomesus psittacus
Mites—	*Hemidoras carinatus*
	Leporinus nigrotaeniatus
	Eigenmannia virescens
Millipedes—	*Pimelodus clarias*
	Leporinus nigrotaeniatus

Fish stomach contents—continued

Dragonfly Larvae—	*Sternopygus macrurus* *Gymnorhamphichthys hypostomus* *Plagioscion auratus*
Orthoptera—	*Colomesus psittacus*
Roaches—	*Potamotrygon hystrix* *Rhamdia sebae* *Chalceus macrolepidoptus* *Cynopotamus essequibensis*
Hemiptera—	*Hemidoras carinatus* *Leporinus arcus* *Creatochanes caudomaculatus* *Hyporhampus roberti*
Moths—	*Chalcinus rotundatus*
Caterpillars—	*Potamotrygon hystrix*
Caddis Larvae—	*Hemidoras carinatus* *Leporinus arcus* *Sternopygus macrurus* *Eigenmannia virescens* *Colomesus psittacus*
Diptera—	*Rhamdia sebae* *Pimelodus ornatus* *Hemidoras carinatus* *Creatochanes affinis* *Creatochanes caudomaculatus* *Holobrycon pesu* *Gastcropelecus sternicla* *Sternopygus macrurus* *Stolephorus surinamensis* *Rivulus stagnatus* *Tomeurus gracilis* *Hyporhamphus roberti* *Plagioscion auratus* *Geophagus surinamensis* *Evorthodus breviceps*
Chironomids—	*Pimelodella cristata* *Pimelodus clarias* *Pygidium guianensis* *Stolephorus surinamensis* *Geophagus jurupari* *Achirus fasciatus* *Colomesus psittacus*
Neuropterous Larvae—	*Pygidium guianensis* *Chalceus macrolepidotus*

Fish stomach contents—continued

	Electrophorus electricus
	Sternopygus macrurus
	Gymnorhamphicthys hypostomus
	Stolephorus surinamensis
Beetles—	*Hemicetopsis macilentus*
	Leporinus nigrotaeniatus
	Moenkhausia grandisquamis
	Creatochanes affinis
	Poecilurichthys abramoides
	Holobrycon pesu
	Chalcinus rotundatus
	Carnegiella strigata
	Gasteropelecus sternicla
	Myloplus rubripennis
	Cynopotamus essequibensis
	Gymnotus carapo
	Eigenmannia virescens
	Eleotris amblyopsis
Ants—	*Pimelodus clarias*
	Leporinus alternus
	Tetragonopterus chalceus
	Moenkhausia grandisquamis
	Pristella riddlei
	Creatochanes affinis
	Creatochanes caudomaculatus
	Poecilurichthys abramoides
	Holobrycon pesu
	Chalceus macrolepidoptus
	Chalcinus rotundatus
	Carnegiella strigata
	Myloplus rubripennis
	Gymnotus carapo
	Sternopygus macrurus
	Rivulus stagnatus
	Hyporhampus roberti
	Crenicichla lugubris
	Colomesus psittacus
Muddy Debris—	*Potomotrygon hystrix*
	Pimelodus clarias
	Callichthys callichthys
	Hoplosternum thoracatum
	Corydoras punctatus
	Plecostomus plecostomus
	Hemiancistrus braueri
	Xenocara gymnorhynchus

Fish stomach contents—continued

	Ancistrus sp.
	Loricaria cataphracta
	Loricariichthys griseus
	Loricariichthys stewarti
	Electrophorus electricus
	Geophagus surinamensis
	Geophagus jurupari
	Eleotris amblyopsis
Vegetable Matter—	*Pimelodella cristata*
	Hemisorubim platyrhynchos
	Doras granulosus
	Hemidoras carinatus
	Trachycorystes obscurus
	Hemicetopsis macilentus
	Bivibranchia protractila
	Curimatus spilurus
	Curimatus schomburgki
	Prochilodus rubrotaeniatus
	Anastomus anastomus
	Laporinus nigrotaeniatus
	Laporinus alternus
	Poeciturichthys abramoides
	Holobrycon pesu
	Brycon falcatus
	Myloplus rubripinnis
	Myloplus rhomboidalis
	Myleus pacu
	Electrophorus electricus
	Gymnotus carapo
	Gymnorhamphichthys hypostomus
	Rivulus stagnatus
	Hyporhampus roberti
	Geophagus surinamensis
	Colomesus psittacus
Seeds—	*Doras granulosus*
Algae—	*Anisitsia notata*
	Leporinus fasciatus
	Creatochanes affinis
	Myleus pacu
	Symbranchus marmoratus
	Eleotris amblyopsis
	Colomesus psittacus
Fish—	*Potamotrygon hystrix*
	Paulicea lutkeni

Fish stomach contents—continued

Brachyplatystoma rousseauxi
Brachyplatystoma vaillianti
Ageniosus marmoratus
Serrasalmo rhombeus
Hydrolicus scomberoides
Cynopotamus essequibensis
Hydrocynus cuvieri
Symbranchus marmoratus
Plagioscion auratus
Crenicichla lugubris
Eleotris amblyopsis

Tadpoles— *Electrophorus electricus*

Class AMPHIBIA

In the quarter mile of research area I have found thirty-seven certainly identified species of Amphibians, together with eight additional species represented only by tadpoles or other insufficient material. The thirty-seven species are grouped in two orders and seven families. One of the most remarkable facts about this Class is the total absence of Urodeles. As far as we know not a single newt or salamander is found in the entire Colony.

Apoda, the first order, with a single family Coecilidae, is represented in my restricted area by only one species, *Siphonops annulatus*, a legless, earthworm-like amphibian. It is a burrowing form, apparently very rare, and in its structure a most remarkable combination of ancestral and specialized characters.

The comparative relationships of the six families of Anura, the toads and frogs, is shown in this table:

	Families	*No. of Species*	*Relative number of of Individuals*	*Relatively dominant Visually*	*Relatively dominant as to Color*	*Relatively dominant as to Style*	*Relatively dominant Aurally*
1	**Pipidae**	2	6	6	6	6	6
2	**Bufonidae**	3	4	1	5	1	3
3	**Hylidae**	11	2	3	1	3	1
4	**Cystignathidae**	11	1	2	3	2	4
5	**Engystomatidae**	4	5	5	4	5	5
6	**Ranidae**	5	3	4	2	4	2

Order ANURA

Family PIPIDAE

The classic Surinam Toad is confined to the Guianas and the adjacent portion of Brazil, but heretofore has been found only on the coast and not in the interior. Up to the present two individuals only of *Pipa americana* have been recorded from the research area, one full-grown. In March 1924 I made a search for Pipas in the pool where a small species was found two years preceding, and although it was almost dried up I discovered five, one large female, a smaller male and three small ones. Later in the year several breeding females were found by Dr. Emerson, and the species confirmed as a second, small member of the genus, *Pipa aspera*.

Family BUFONIDAE

Three toads inhabit this area, two of them common. One of these, the Marine Toad, might be termed familiar, for it lives about, and even in and under the laboratory, and offers little objection to capture and handling. Its catholicity of taste in diet is astonishing, quite as much so as its almost complete lack of enemies.

Were mankind an important factor in this area, this toad would be of the utmost value, for it feeds on the most noxious insects. In the stomach of a medium-sized individual over seven hundred Attas or leaf-cutting ants were found, besides fifty other ants, millipedes, centipedes and scorpions. The very young toads devour ticks, mites and bête rouge. The deep-throated, continuous roar of these frogs is heard off and on throughout the year, but is at its height during the first part of the rainy seasons. The sound carries over a mile across the water. The Marine Toad excels all other Kartabo amphibians in size, reaching a weight of one and one-half pounds, and in vocal power is surpassed only by the Giant Hyla.

Family HYLIDAE

The tree-toads form one of the most characteristic and interesting tropical families of amphibians. Eleven species have been found in the research area. Probably one-third as many more remain to be discovered when the tree-tops and the ultimate leaves of the deep jungle have yielded their batrachian secrets. The most brilliant colors are found here and voices which far outdo all other sounds of the night. *Hyla rubra* is the familiar of this group, coming into the laboratory and depositing its eggs in our aquariums and vivariums.

Family CYSTIGNATHIDAE

In this family are included eleven frogs varying in form from the amazing huge-headed *Ceratophrys* and the nine-inch tadpole of *Pseudis* to the tiny *Leptodactylus minutus*. Those of the genus *Leptodactylus* are strong, fierce creatures, never reconciled to captivity, cannibals on occasion, with many strange habits such as uttering an appalling scream when captured.

Family BREVICIPITIDAE

Four anomalous species, chiefly walkers, and except *Atelophus*, swamp burrowers, extremely difficult to find. All are rare.

Family RANIDAE

Two little leaf-walkers are common and noisy in the rains, the male *Dendrobates* carrying the tadpoles about upon his back. The green Guiana Bull-frog is found along the shore and also deep in the jungle.

Enemy and Prey Ecology

Enemies of Amphibians

Twenty species of vertebrates have been found to prey on Amphibians:

Two fish—*Plagioscion* and *Serrasalmo*.

Four amphibians devour their own kind, three species of *Leptodactylus*, while the tadpoles of *Phyllomedusa* aggressively attack and devour other species of tadpoles.

Seven species of snakes, *Herpetodryas* (2 sp.), *Bothrops* (2 sp.), *Liophis*, and *Xenodon* (2 sp.), feed on seven species of *Anura*.

Five birds, *Europyga, Theristicus, Ardea, Cochlearius* and *Urubitinga*.

Two mammals, *Lutra* and *Nasua*.

AMPHIBIAN STOMACH CONTENTS

Isopods—	*Leptodactylus pentadactylus* *Phyllobates inguinalis* *Dendrobates*
Scorpions—	*Leptodactylus pentadactylus*
Crabs—	*Hyla maxima*

Amphibian stomach contents—continued

Pseudoscorpions—	*Dendrobates*
Harvestmen—	*Bufo marinus*
Spiders—	*Bufo marinus* *Leptodactulys caliginosus* *Phyllobates inguinalis*
Acarina—	*Bufo marinus* *Bufo marinus* (newly hatched)
Myriopods—	*Bufo marinus* *Dendrobates* *Leptodactylus pentadactylus*
Chilopods—	*Bufo typhonius*
Insecta—	
Thysanura—	*Leptodactylus pentadactylus* *Dendrobates*
Isoptera—	*Hyla pardalis* Yellow green *Hyla* *Leptodactylus caliginosus* *Gastrophryne ovale* *Atelopus flavescens* *Gastrophryne microps* *Phyllobates inguinalis*
Orthoptera—	*Bufo marinus* *Hyla pardalis* *Hyla rubra* *Leptodactylus caliginosus* *Leptodactylus mystacinus* *Leptodactylus stictigularis* *Leptodactylus pentadactylus* *Phyllobates inguinalis* *Hyla maxima* *Hyla albomarginata*
Hemiptera—	*Bufo marinus* *Leptodactylus pentadactylus* *Leptodactylus caliginosus* *Leptodactylus mystacinus*
Membracids—	*Phyllobates inguinalis* *Hyla albomarginata*
Lepidoptera—	*Hyla rubra*

Amphibian stomach contents—continued

Diptera—	*Bufo marinus*
	Bufo guttatus
	Leptodactylus caliginosus
Coleoptera—	*Bufo marinus*
	Bufo typhonius
	Bufo guttatus
	Hyla rubra
	Hyla boans
	Leptodactylus lineatus
	Leptodactylus pentadactylus
	Leptodactylus caliginosus
	Leptodactylus mystacinus
	Leptodactylus rhodomystax
	Phyllobates inguinalis
Hymenoptera—	
Ants—	*Bufo marinus*
	(a. 700 Attas, 50 *Pachycondyla.*)
	(b. 400 Attas.)
	Bufo typhonius
	Bufo guttatus
	Hyla rubra
	Leptodactylus caliginosus
	Leptodactylus mystacinus
	Gastrophryne microps
	Dendrobates
	Phyllobates inguinalis
Hymenoptera—	
Wasps—	*Bufo marinus*
	Leptodactylus stictigularis
Vertebrates—	
Frogs—	*Leptodactylus pentadactylus*
	Leptodactylus caliginosus
	Leptodactylus stictigularis
	Phyllomedusa bicolor (tadpoles carnivorous)

Class REPTILIA

Within the research area at Kartabo I have collected ninety-three species of reptiles. Although there is no special list of the reptiles of British Guiana, in literature I find mention of one hundred and twenty forms. Hence over seventy-seven percent of this colonial total is represented in the quarter mile under observation.

Four orders are included and nineteen families, and there undoubtedly remain many more species as yet undetected.

	Number of Families	Number of Species	Relative Number of Individuals	Relative Dominance Visually	Relative Color Dominance	Relative Extreme in Size	Relative Danger to Man
I—Testudinata	5	8	III	III	III	IV	—
II—Crocodilia	1	2	IV	IV	IV	II	II
III—Lacertilia	5	31	I	I	II	III	—
IV—Serpentes	6	52	II	II	I	I	I

Class REPTILIA

Order TESTUDINATA

Tortoises and turtles form a very unimportant group of Kartabo organisms, both in number of species and in specimens. Five families are represented, and eight species.

Family CINOSTERNIDAE

Cinosternum scorpioides: This species appears to be confined to Guiana and is the only South American representative of the family of our common mud turtle of New York. Only two small specimens have been found in the research area.

Family TESTUDINIDAE

Nicoria punctularia: This turtle is not rare, a half dozen being found in the creeks each season.

Testudo denticulata: This bright-colored land tortoise is the only common Chelonian in the area, and is frequently to be found wandering about in the jungle, in both dense and open growths. They reach an unusually large size, over two and a half feet in length of shell, but apparently breed when quite small. I have heard them utter musical grunts during the breeding season. Three times they have been found freshly scooped out of their shells, probably the work of an ocelot or jaguar.

Family CHELONIDAE

Chelonia mydas: Only two sea turtles have been recorded, both very small, one from below and the other just up-river from the station. The eggs of this species are common in sand banks in the Essequibo above Bartica, where they are dug out and eaten by the Indians.

Family PELOMEDUSIDAE

Podocnemis unifilis; Podocnemis expansa: Two young specimens and one adult of the first species, and a single adult of the second taken from the jungle creeks.

Family CHELYDIDAE

Chelys fimbriata: No mata-mata has been found within the exact research area but there are records a very short distance away to the north in Çauria Creek (two specimens reported by warder and convicts), one medium specimen east, from Kalacoon, and one from the south, just this side of Ororabo. The largest measured was eighteen inches, the smallest five and a half inches in length.

Platemys platycephala: The flat-shelled turtle is found only at the mouth of jungle creeks. Several six-inch individuals have been taken north alive.

Order CROCODILIA

Family CROCODYLIDAE

Caiman niger: The giant black crocodile of the upper reaches of the rivers of Guiana has been seen only twice near the Station. A ten or twelve foot specimen spent several days on a ledge of rocks a few hundred yards from the laboratory in 1920, and a second was observed by me on the shore some distance up the Cuyuni.

Caiman sclerops: The common crocodile of the rivers hereabouts. Four or five foot individuals nest in the trenches about the Penal Settlement, and small ones are occasionally taken in fishermen's nets near the Station. A young male three feet long and weighing five pounds had the following in its stomach:

Many small, white quartz stones,
Two large spiders,
Fifteen lizard and fish bones,
Three pieces of half-burned wood.

Order LACERTILIA

The lizards of the Kartabo quarter square mile, as in most places in the tropics, are an important group. Of the four orders of Reptilia they are first in point of number of individuals and visual dominance, second in species and brilliance of color, and third in extreme size.

Thirty-one species have been identified with certainty, varying in size from tiny geckos an inch and a half in total length to iguanas

Fig 12 A jungle Anolis one of the common lizards
Photograph by John Tee-Van

over six feet from snout to tail-tip. These are scattered through five families, of which Iguanidae has ten and Teiidae sixteen species. Twenty-one genera complete the group divisions.

While there is considerable change of color among a number of species, yet the pigmentation as a rule, both as to pattern and color, reflects the particular haunts of the various species. The ground forms, like Mabuia, are brown, or ruptively colored green and brown as Ameiva. The trunk-loving forms are grey as in Ophryoessa, or brown like the Geckos, and the foliage-haunting species are green, such as Iguana, Polychrus, Plica and some Anoli. The burrowing lizards such as Amphisbena are white, black or irregularly blotched.

In distribution the lizards of Kartabo range from the topmost branches of trees to several yards underground. Only one form is adaptively aquatic, although most can swim readily when need arises. The following represents in a general way the zone in which the various genera are usually found:

AQUATIC		*Neusticurus*
BURROWING		*Cophias*
		Amphisbena
TERRESTRIAL		
	Jungle	*Tupinambis*
		Iphisa
		Leposoma
		Mabuia
	Near Clearings	*Ameiva*
		Cnemidophorus
		Prionodactylus
ARBOREAL		
	Logs and Hollow Trees	*Gonatodes*
		Thecadactylus
		Sphaerodactylus
	Low Trunks and Branches	*Anolis* (brown)
		Tropidurus
		Centropyx
		Ophryoessa
	Trunks, Mid-Jungle	*Plica*
	Foliage, Mid-Jungle	*Polychrus*
	Foliage, Low-Jungle	*Anolis* (green)
	Near Creeks and Clearings	*Iguana*
IN HOUSES		*Thecadactylus*
		Sphaerodactylus

As regards occurrence no species in undisturbed environment can be said to be abundant. The numbers of the two Geckos in the laboratory itself and the young Ameivas and Cnemidophorus which scamper about the compound are adaptations to the altered conditions induced by our occupation. In the jungle the brown forms of Anolis and the two clearing lizards mentioned are common, but all others are occasional or rare.

ENEMY AND PREY ECOLOGY

Lizards are eaten by at least thirteen vertebrates in the quarter mile under observation, these being three snakes, nine birds and one mammal. All three species of the Cotingine genus *Attila* feed to a

large extent on small lizards, as does the Furnarian *Automolus*. The two hawks *Leucopternis* and *Gampsonyx* devour *Cnemidophorus*, as does the snake *Oxybelis*, while *Elanoides* catches *Polychrus*, *Harpagus* eats *Anolis*, and *Boa constrictor* and *Clelia* kill *Ameiva*. The coati-mundi, *Nasua*, takes lizard eggs whenever he finds them, and in one individual I found three of the rare *Cophias flavesçens*.

Of the thirty species of lizards only one is a strict vegetarian. This is *Iguana*, while *Polychrus* eats berries and leaves as often as animal food. The only vertebrates so far found in a lizard's diet are *Cnemidophorus* and the spiny rat, *Proechimys*, eaten by *Tupinambis*.

LIZARD DIET

Leaves	*Iguana* *Polychrus*
Berries	*Polychrus*
Earth Worms	*Anolis*
Mollusks	*Thecadactylus*
Crabs	*Tupinambis*
Isopods	*Cophias*
Millipedes	*Plica* *Ophryoessa*
Centipedes	*Anolis* *Plica*
Acarina	*Thecadactylus*
Spiders	*Tupinambis* *Anolis*
Cicadas	*Plica*
Moth Flies	*Thecadactylus*
Mosquitoes	*Anolis*
Crane Flies	*Leposoma*
General Diptera	*Thecadactylus*
Termites	*Anolis* (two species) *Thecadactylus*
Wood Roaches	*Sphaerodactylus* *Anolis* *Thecadactylus*

Lizard diet—continued

Mole Crickets	*Amphisbena* *Anolis*
Long-Horned Grasshoppers	*Polychrus* *Tupinambis* *Plica*
Beetles	*Plica* (two species) *Polychrus* *Tupinambis* *Centropyx* *Amphisbena* *Thecadactylus* *Anolis* *Cophias*
Microlepidoptera	*Cophias*
Caterpillars	*Anolis* *Ophryoessa*
Wasps	*Tupinambis*
Ants	*Anolis* (two species) *Plica* (two species) *Tupinambis* *Cophias* *Thecadactylus*
Cnemidophorus	*Tupinambis*
Spiny Rat	*Tupinambis*

I have omitted the two most abundant species of lizards, *Ameiva* and *Cnemidophorus*, from this list, in order to demonstrate the wide range of diet of these ground saurians, and the interesting comparison of relative numbers. I have selected forty individuals of each and have ranged the items of diet in the order of their number of occurrences:

Diet of Two Lizard Species

Ameiva		*Cnemidophorus*	
Roaches	18	Beetles	18
Beetles	16	Grasshoppers	15
Grasshoppers	14	Spiders	13
Centipedes	9	Wasps	11
Spiders	8	Caterpillars	7
Scorpions	7	Ants	5

Diet of two lizard species—continued

Ants	7	Flies	5
Snails	4	Roaches	4
Millipedes	4	Crickets	3
Termites	4	Heteroptera	3
Mantids	3	Bees	3
Caterpillars	3	Beetle larvae	2
Diptera	3	Centipedes	2
Dipterous larvae	2	Snails	2
Crickets	2	Fruit	2
Earth worms	1	Cnemidophorus tails	1
Earwigs	1	Butterflies	1
Hemiptera	1	Membracids	1
Wasps	1	Termites	1
		Dragonflies	1
		Mole crickets	1
		Crabs	1
		Flowers	1

The breeding of the lizards of Kartabo, when charted, resolves into two unequal nodes, both occurring at the end of the rains, or the beginning of the dry seasons. April, May, October and November are the low months, and January, July and August the high ones, the latter being the month of intensest breeding by several hundred per cent. The latitude of breeding throughout the year is probably considerably greater than is apparent from my records. *Anolis* shows the following relative mensual percentages of breeding records:

January	10 per cent.	July	10 per cent.
February	20 " "	August	30 " "
March	10 " "	November	10 " "
April	10 " "	December	20 " "

The monthly distribution by genera follows:

January	*Anolis*	June	*Tupinambis*
	Polychrus		*Leposoma*
	Iguana		*Cophias*
February	*Anolis*	July	*Gonatodes*
March	*Anolis*		*Thecadactylus*
	Leposoma		*Sphaerodactylus*
April	*Anolis*		*Anolis*
May	*Leposoma*		*Polychrus*
			Ophryoessa

August	*Gonatodes*	September	*Plica*
	Thecadactylus	October	*Plica*
	Sphaerodactylus	November	*Anolis*
	Anolis	December	*Anolis*
	Polychrus		
	Ophryoessa		
	Mabuia		

Order LACERTILIA

Family GECKONIDAE

Although not especially common in the jungle yet these little vacuum-toed lizards are the first to be seen at Kartabo, for all three genera are found in the laboratory itself. The tiny *Sphaerodactylus* come commonly about our tables and creep about the glass of the windows, snatching minute insects. The most abundant species is apparently undescribed.

The larger *Thecadactylus* are nocturnal and scurry over the walls and ceiling after moths and roaches. The natives call them Gongasockas and consider them deadly not only as to bite but even to touch. A gecko larger but congeneric with the spot-shouldered *Gonatodes*, and possessing brilliant blue eyes, has proved to be new and been named *Gonatodes beebei*. In the jungle all these geckos haunt low stumps and dead logs.

Family IGUANIDAE

Twelve species represent this family, varying widely in size, coloring, habits and haunts. The commonest of all lizards are the jungle *Anolis*, confusing as to species as they are quick to the eye. They make delightful pets, soon becoming tame and leaping upon one's hand for food. In quickness and general activity they approximate birds. Those living among low growths near the leaves on the jungle floor are of various shades of brown and grey, while the *Anolis* of higher foliage are green.

Polychrus is one of the most beautiful and interesting of Kartabo lizards. It has a complete color change from brown to green, with many variations of pattern, and is adapted to its life among the mid-foliage of the jungle not only in color but in pose. It often assumes most grotesque postures with the long, slender tail draped, tendril-like, over the leaves, and one or two of its feet

sprawled in mid-air, thereby losing all semblance to a thing of life. The *Plicas* are also leaf and branch colored, but *Ophryoessa* equals *Polychrus* in perfection of adaptation to its haunts. It invariably clings lengthwise to a twig or upright dead stem, and so closely that the eye cannot distinguish between bark and saurian, while the color in both is identical. Unlike the lizards less adapted to their surroundings, *Ophryoessa* will allow one's fingers to close about it before attempting to escape, relying as much on the perfection of its protection as does a skunk or a porcupine.

Iguana is unique in being a vegetarian, and adumbrates evolution of avian flight in its leaps from tree-tops into the water of creeks.

Family TEIIDAE

Tupinambis, the Salempenta of the natives, if three times its natural size of a yard in length would be of greater danger than a full-grown crocodile. It is the nearest Kartabo suggestion of one of the fierce extinct saurians, feeding on any small mammals and birds or reptiles which it can capture and overcome, and, in addition being an omnivorous scavenger. It is a great yellow and black inmate of the jungle, living in holes and rushing about with the noise of a herd of alarmed peccaries.

Ameiva and *Cnemidophorus* are the familiars of the jungle lizards, and *Neusticurus* is found only in and about creeks through the waters of which it swims and dives skilfully. *Cophias* is a good example of a lizard with limbs so tiny that they function only when creature is moving slowly.

Family AMPHISBAENIDAE

Degeneration of the limbs is carried to an extreme in this family, which, to outward view, are serpents. Two species are found, both burrowers underground in general.

Family SCINCIDAE

Two scinks have so far been recorded, little brown, smooth-scaled, active creatures, rather rare, which produce usually four young alive at a birth, of an astonishingly large size.

Order SERPENTES

In spite of the fact that snakes are far from common, and one may tramp for miles and for days through the jungle without ever

catching a glimpse of one, I have recorded fifty-two species from the research area. These are divided into thirty-four genera and distributed along the following eight families:

Leptotyphlopidae	1 genus	2 species
Typhlopidae	1 "	1 "
Boidae	4 "	5 "
Ilysiidae	1 "	1 "
Colubridae	21 "	30 "
Elaphidae	1 "	3 "
Amblycephalidae	2 "	5 "
Crotalidae	3 "	5 "

There are eight forms of poisonous snakes, belonging to four genera. One, *Crotalus*, has been recorded only once from the quarter mile area, and a second time outside at Kalacoon, and is decidedly a stray from more open, savanna country. The noxious species range in size from the small coral snakes, *Micrurus*, to great bush masters, *Lachesis*, eight and a half feet long. The harmless species are represented on the one hand by such diminutive forms as *Atractus*, and on the other by mighty boa constrictors and anacondas, *Boa* and *Eunectes*, fifteen to twenty feet long.

In this extremity of size the snakes rank first among the orders of reptiles, as they do also in danger to man and in general brilliance of coloring. In number of individuals they come second to lizards, but again hold first place in actual number of species.

Their haunts are hardly more limited than with the lizards, the great majority being terrestrial, but with burrowing forms such as *Leptotyphlops*, *Typhlops*, *Atractus* and *Micrurus*, aquatic as *Eunectes*, or somewhat less water-loving forms such as *Helicops* and *Hydrops*, while a few snakes are adapted solely for an arboreal life, as *Oxybelis* and *Leptophis*.

No snake can be said to be abundant nor even common. Occasional is the most that can be adduced of half a dozen forms, while the records of the remainder show them to be rare or unique.

I have found only three vertebrates feeding on snakes. Two of these were snakes themselves, *Clelia* and *Erythrolamprus*, and the third an owl, *Pulsatrix*, in which case, however, both snake and bird succumbed.

Snakes include twenty-two vertebrates in their diet, two fish, eight amphibians, five reptiles, four birds and four mammals. The detailed food of twenty-three species follows:

SNAKE STOMACH CONTENTS

Earth Worms	*Erythrolamprus*
Slugs	*Leptognathus variegatus*
Spiders	*Xenodon*
Grasshoppers	*Xenodon*
Atta Soldiers	*Leptotyphlops* *Typhlops* *Xenodon*
Insects, General	*Tantilla* *Erythrolamprus* *Micrurus* *Xenodon*
Symbranchus	*Hydrops* *Micrurus*
Plagioscion	*Eunectes*
Gastrophryne microps	*Xenodon*
Leptodactylus mystacinus	*Liophis* *Drymobius* *Herpetodryas*
Leptodactylus pentadactylus	*Bothrops*
Leptodactylus caliginosus	*Herpetodryas*
Hyla rubra	*Herpetodryas*
Hyla maxima	*Herpetodryas* *Bothrops*
Bufo marinus	*Xenodon* (two species)
Bufo typhonius	*Xenodon*
Atractus trilineatus	*Erythrolamprus*
Boa constrictor	*Clelia*
Anolis	*Oxybelis*
Cnemidophorus lemniscatus	*Oxybelis*
Ameiva ameiva	*Clelia* *Boa*
Sporophila eggs	*Phrynonax*

Fig. 13.—*Corallus caninus;* a tree boa whose scales are colored green, yellow and white. Photograph by John Tee-Van.

Snake stomach contents—continued

Domestic Chickens	*Epicrates* *Herpetodryas* *Xenodon*
Pipra leucocilla	*Bothrops*
Nectomys sp.	*Herpetodryas*
Oecomys sp.	*Lachesis*
Proechimys cayennensis	*Lachesis*
Bradypus cuculliger	*Eunectes*

Breeding records of oviparous snakes extend from March 27th to October 9th with no noticeable concentration about any one month or season.

As will be mentioned later, coral snake mimicry is well marked, a few specimens of *Ilysia, Hydrops* and *Clelia petolaria* being found in close association with a much larger number of *Micrurus marcgravii.* The native Indians distinguish readily between the ordinary and "hot" snakes as they call the poisonous species. Occasionally a negro gets a charm which he considers an absolute safeguard and I have seen such a man handle bushmasters and fer-de-lance with almost no precautions against a bite. In a period of seven years I have had two rather narrow escapes from being bitten, but have never heard of anyone bitten anywhere in the neighboring district.

Order SERPENTES

Family LEPTOTYPHLOPIDAE

Two species of small burrowing serpents which seem confined to the interior of termite and ant nests.

Family TYPHLOPIDAE

A single species of these burrowing *Typhlops* lives in my quarter square mile of jungle, coming rarely to the surface.

Family BOIDAE

Five boas have been recorded, all of striking coloring and two reaching a large size. The green tree boa, *Corallus caninus,* is a blaze of green, yellow and white; the anaconda, *Eunectes,* the great snake of the water, is not uncommon, while the boa constrictor occupies the same position on land.

Family ILYSIDAE

The harmless, false coral snake *Ilysia* is the only representative of this family, and burrows in damp places, often in the vicinity of true coral snakes.

Family COLUBRIDAE

Like the heterogeneous avian assemblage Coraciiformes, this consists of thirty species whose diversity of habits and outward appearance are of less importance than internal structure. *Oxybelis*, long and slender, haunts the trees, while *Xenodon*, short and thick, is wholly terrestrial, flattens its head into a perfect viperine resemblance, and feeds on such noxious things as *Bufo marinus*. *Hydrops*, semi-aquatic, resembles and associates closely with *Micrurus*, and feeds on the same food, the eel *Symbranchus*. None of the colubrian snakes can be said to be common, however, in the sense that they can be found whenever searched for.

Family AMBLYCEPHALIDAE

Five small, variegated snakes of gentle disposition and conservative habits represent this family.

Family CROTALIDAE

Five really dangerous snakes complete the list of Ophidia, but all are so rare that sometimes a month of daily tramping through the jungle fails to reveal one. *Lachesis mutus*, the notorious bushmaster is found always coiled in a close circle on the jungle floor. It makes no movement on being approached, but invariably one's eye is drawn toward it while still several steps away. Whether this is from a subconscious alert perception, or the unconscious detection of a delicate odor I cannot say. When this serpent is alarmed, its odor becomes unpleasantly strong and musky. The largest individual seen, which was captured alive,[4] measured eight feet six inches in length.

The fer-de-lance, *Bothrops lanceolatus*, is much more often observed. Many small ones have been taken from the bamboo clumps around the laboratory. Of twenty-two specimens examined two were females with well-formed embryos. The arboreal green fer-de-lance *Bothrops bilineatus*, has been found only twice, the first time when one struck at my hat as I crouched under a bush.

[4] Jungle Peace, pp 188–195.

Class AVES

Within the quarter of a square mile of research area at Kartabo there have been observed four hundred and sixty-four species of birds. From the Colony of British Guiana as a whole there have been recorded seven hundred and sixteen species. Hence in an area one-three hundred and sixty thousandth of the whole of Guiana, I have observed about sixty-four percent of the total number of birds.

The birds of Kartabo form fifty-six percent of all the vertebrates. In number of species, and in visual, color and vocal dominance the birds stand first, yielding only to fish and amphibians in point of number of individuals, and to fish, reptiles and mammals in extremes of size. Insects are the only other organisms which stand comparison in point of general dominance.

As regards a general survey of the avifauna of Kartabo, I need add little to my chapter on the Bird Life of Bartica District (which includes Kartabo) in "Tropical Wild Life" pp. 91–137. The point of greatest interest in comparing the present work with this chapter is the remarkable result of intensive work in a restricted field. My notes in the earlier volume included the large collections made by professional skin collectors at Bartica, together with my notes on the whole of this region, numbering in all three hundred and fifty-one species.

As an introduction to a general survey of Kartabo birds I am reproducing from a Bulletin of the Zoological Society, an account of a Christmas bird census which will give an idea of the bird life which may be observed in the quarter mile area in a single day.

It always has been an exciting feat to see how many birds one can see within a given time or limited area. Birds of a city backyard, or a month's visitors to a bramble patch, offer a gamble which is fascinating to the human mind. I once took the greatest joy in recording seventy-six species of birds within a week, in a single tree in Brazil. This widespread human interest has been used for years with most important results by Dr. Chapman in "Bird Lore," whose Christmas census lists I always peruse with as much care and interest as if I had personally been a member of every party.

Mr. Inness Hartley and I once decided to make a Christmas census of the birds about our jungle laboratory at Kartabo, British Guiana, but this date occurs toward the end of the short rainy season, and their particular Christmas was a very unusual day—as

it rained from 5:00 A. M. to 5:30 P. M. The following day was almost as bad, so we had to compromise on the 27th of December, 1920.

From dawn to dark we covered considerable ground. One trip in the launch was made a short distance down the Mazaruni River, a walk was taken along the beach, two trips through the clearing about the tents and bungalow, and four trips in the jungle, all within a quarter-mile circumference. All the observations were made by Inness Hartley or myself, and we were out for about half the day—at various times from 5:30 A.M. to dark at 6:00 P. M.

On this 27th of December, 1920, the temperature was 72° at 6:00 A. M., 81° at noon, and 76° at 6:00 P. M. The morning was quiet, while the trade wind blew gently from 1:00 to 6:00 P. M. The morning was cloudy up to 11:30 A.M., while four heavy showers fell between noon and 4:00 P. M., with bright sun between them.

We observed 116 species of birds, distributed among 418 individuals. Of these a swift and a vulture may be classed as aerial; nine as water or shore birds; eighteen as inhabitants of the clearing, and the remaining eighty-seven tenants of the jungle itself. We had been studying the birds hereabouts for seven months, and yet it is so difficult to identify birds in the high trees with any certainty that we had to shoot about twenty species to be sure of them. Besides those which we identified, we each saw at least twenty or thirty more whose identity escaped both glass and gun.

Several, such as the goldbird and the giant goatsucker or poor-me-one, were identified from the call alone—this being absolutely unmistakable.

It is interesting to note that thirty-seven species or 31 per cent of the whole, were named by Linnaeus, emphasizing the interest of this region as the origin of most of the collections which he named over one hundred and fifty years ago.

No. Seen	*Common Name*	*Scientific Name*
Two	Guiana Great Tinamou	*Tinamus major major* (Gmel.)
Two	Variegated Tinamou	*Crypturus variegatus variegatus* (Gmel.)
One	Crested Curassow	*Crax nigra* Linné
One	Lesser Olive Guan	*Penelope marail* (P. L. S. Mull.)
Three	Little Chachalaca	*Ortalis motmot* (Linné)
One	Guiana Partridge	*Odontophorus guianensis guianensis* (Gmel.)
Two	Purple-tinted Pigeon	*Oenaenas purpureotincta* (Ridg.)

Bird census—continued

Six	Talpacoti Ground Dove	*Chaemepelia talpacoti* (Temm. & Knip.)
Three	Great-billed Tern	*Phaetusa chloropoda* (Vieill.)
Two	Common Tern	*Sterno hirundo* (Linné)
Two	Collared Plover	*Charadrius collaris* (Vieill.)
Two	Spotted Sandpiper	*Actitis macularia* (Linné)
One	Little Blue Heron	*Florida caerulea caerulea* (Linné)
Three	Yellow-headed Vulture	*Cathartes aura urubitinga* (Pelz.)
Three	Red-throated Caracara	*Ibycter americanus* (Bodd.)
One	Black-faced Hawk	*Leucopternis melanops* (Lath.)
One	Swallow-tailed Kite	*Elanoides forficatus yetupa* Bonn. & Vieill.
Four	Red-and-Yellow Macaw	*Ara macao* (Linné)
Five	Mealy Amazon	*Amazona farinosa farinosa* (Bodd.)
One	Dusky Parrot	*Pionus fuscus* (P. L. S. Mull.)
Eight	Purple Guiana Parrot	*Touit purpurata* (Gmel.)
Two	Black-headed Caique	*Pionites melanocephala melanocephala* (Linné)
Two	Great Gray Kingfisher	*Megaceryle torquata cyanea* (Vieill.)
Two	Little Green Kingfisher	*Chloroceryle americana americana* (Gmel.)
Two	Guiana Motmot	*Momotus momota momota* (Linné)
Two	Giant Goatsucker	*Nyctibius griseus griseus* (Gmel.)
One	White-necked Nighthawk	*Nyctidromus albicollis albicollis* (Gmel.)
Twenty	Swift	*Chaetura* sp.
One	Cayenne Hermit	*Phaethornis superciliosus superciliosus* (Linné)
Three	Red-vented Hermit	*Phaethornis ruber ruber* (Linné)
One	Broad-shafted Sabrewing	*Campylopterus largipennis* (Bodd.)
Two	Black-eared Fairy	*Heliothrix aurita aurita* (Gmel.)
Six	Black-throated Trogon	*Trogonurus curucui curucui* (Linné)
Three	Green Trogon	*Trogon strigilatus strigilatus* (Linné)
Three	Southern Trogon	*Chrysotrogon violaceus violaceus* (Gmel.)
Two	Black-tailed Trogon	*Curucujus melanurus melanurus* (Swainson)
Six	Common Ani	*Crotophaga ani* Linné
Two	Black-spotted Barbet	*Capito niger* (P. L. S. Mull.)
Five	Sulphur- and White-breasted Toucan	*Ramphastos vitellinus* Licht.
One	Green Aracari	*Pteroglossus viridis* (Linné)

Bird census—continued

Two	Golden Jacamar	*Jacamerops aurea* (P. L. S. Mull.)
One	Collared Puffbird	*Bucco capensis* Linné
Three	Swallow Puffbird	*Chelidoptera tenebrosa tenebrosa* (Pall)
One	Spix's Amazonian Woodpecker	*Celeus undata* (Linné)
One	Red-necked Woodpecker	*Scapaneus rubricollis* (Bodd.)
Two	Lineated Woodpecker	*Ceophloeus lineatus lineatus* (Linné)
Three	Undulated Piculet	*Picumnus buffoni undulatus* Hargitt
One	Ashy-backed Bushbird	*Dysithamnus mentalis spodionotus* Salv. & God.
Five	Mouse-colored Bushbird	*Hypolophus murinus* (Scl. & Salv.)
Eight	Cinereous Bushbird	*Thamnomanes glaucus* Cab.
Three	Pygmy Antbird	*Myrmotherula pygmea* (Gmel.)
Five	Rufus-bellied Antbird	*Rhopias guttata* (Vieill.)
Twelve	White-flanked Antwren	*Myrmopagis axillaris axillaris* (Vieill.)
One	Gray-breasted Antbird	*Myrmopagis cinereiventris cinereiventris* (Scl. & Salv.)
Two	Spotted-tailed Antbird	*Herpsilochmus sticturus sticturus* Salvin
Three	White-bellied Antwren	*Rhamphocaenus albiventris albiventris* Sclater
Six	White-fronted Antcatcher	*Pithys albifrons* (Linné)
One	Rufus-fronted Antcatcher	*Anoplops rufigula rufigula* (Bodd.)
Five	Schomburgk's Antcreeper	*Myrmoborus leucophrys angustirostris* (Cab.)
One	Woodcock Antbird	*Rhopoterpe torquata torquata* (Bodd.)
One	Black-faced Ant-thrush	*Formicarius colma* subsp.
Two	Guiana Spinetail	*Synallaxis gujanensis gujanensis* (Gmel.)
Five	Dusky-vented Philydor	*Philydor erythrocercus erythrocercus* (Pelz.)
Two	Brown-tailed Xenops	*Xenops genibarbis genibarbis* Ill.
Three	Little Wedge-billed Woodhewer	*Glyphorhynchus cuneatus* subsp.
Two	Guiana Spotted Woodhewer	*Xiphorhynchus guttatus sororius* (Berl. & Hart.)
One	Chestnut-rumped Woodhewer	*Xiphorhynchus pardalotus* (Vieill.)
One	Rufus-throated Woodhewer	*Dendrexetastes rufigula* (Less.)
One	Guiana Curve-billed Woodhewer	*Campylorhampus trochilirostris procurvoides* (Lafr.)

Bird census—continued

One	British Guiana Flatbill	*Craspedoprion olivaceus guianensis* McConnell
Two	Pelzeln's Flatbill	*Rhynchocyclus sulphurescens* subsp.
Two	Spotted Tody Flycatcher	*Todirostrum maculatum maculatum* Desmarest
One	Helmeted Pygmy Tyrant	*Colopteryx galeatus* (Bodd.)
Four	Oily Flycatcher	*Pipramorpha oleaginea oleaginea* (Licht.)
Three	Yellow-vented Flycatcher	*Elaenea martinica flavogaster* (Thun.)
Three	Small-billed Kiskadee	*Myiozetetes cayennensis cayennensis* (Linné)
Nine	Guiana Kiskadee	*Pitangus sulphuratus sulphuratus* (Linné)
Four	Lesser Kiskadee	*Pitangus lictor lictor* (Licht.)
Two	Pitangua Flycatcher	*Megarhynchus pitangua* (Linné)
Three	Whiskered Flycatcher	*Myiobius barbatus barbatus* (Gmel.)
One	Royal Great Crest	*Onycorhynchus coronatus coronatus* (P. L. S. Mull.)
Seven	White-throated Kingbird	*Tyrannus melancholicus satrapa* (Cab. & Hein.)
Two	Golden-headed Manakin	*Pipra erythrocephala erythrocephala* (Linné)
Two	White-crowned Black Manakin	*Pipra leucocilla leucocilla* (Linné)
Three	Crackling Manakin	*Manacus manacus manacus* (Linné)
Four	Black-tailed Tityra	*Tityra cayana* (Linné)
Two	Goldbird	*Lathria cinerea cinerea* (Vieill.)
Five	Spix's Attila	*Attila thamnophiloides* Spix
Three	Cayenne Chatterer	*Cotinga cayana* (Linné)
Two	Pompadour Chatterer	*Xipholena punicea* (Pallas)
Three	Variegated Swallow	*Iridoprocne albiventris* (Bodd.)
Four	Gray-breasted Martin	*Progne chalybea chalybea* (Gmel.)
Four	White-banded Swallow	*Atticora fasciata* (Gmel.)
Three	Guiana House Wren	*Troglodytes musculus* subsp.
One	Quadrille Bird	*Leucolepis musica musica* (Bodd.)
Two	Sabian Thrush	*Planesticus fumigatus* subsp.
Three	Guiana Woodbird	*Pachysylvia muscicapina muscicapina* (Scl. & Salv.)
One	Yellow Warbler	*Dendroeca aestiva aestiva* (Gmel.)
Five	Chestnut-bellied Seedeater	*Sporophila castaneiventris* Cab.
Seven	Olive Kernel-eater	*Pitylus canadensis canadensis* (Linné)

Bird census—continued

Three	Guiana Bananaquit	*Coereba chloropyga guianensis* (Cab.)
Four	Turquoise Honey Creeper	*Dacnis cayana cayana* (Linné)
Eleven	Green Honey Creeper	*Chlorophanes spiza spiza* (Linné)
One	Violaceus Euphonia	*Tanagra violacea violacea* (Linné)
Two	Chestnut-headed Tanager	*Tangara gyrola* (Linné)
Six	Yellow-bellied Tanager	*Tangara mexicana mexicana* (Linné)
Eight	Blue Tanager	*Thraupis episcopus episcopus* (Linné)
Two	Eastern Palm Tanager	*Thraupis palmarum melanoptera* (Sclater)
Eighteen	Silver-beaked Tanager	*Ramphocelus carbo carbo* (Pall.)
Two	Fulvus-crested Tanager	*Tachyphonus surinamus surinamus* (Linné)
Two	Golden-crested Tanager	*Tachyphonys intercedens* Berl.
Fifty	Great Black Cacique	*Ostinops decumanus decumanus* (Pall.)
One	Yellow-backed Cacique	*Cacicus cela* (Linné)
Two	Rice-grackle	*Cassidix oryzivora oryzivora* (Gmel.)
Three	Red-breasted Blackbird	*Leistes militaris militaris* (Linné)
One	Moriche Oriole	*Icterus chrysocephalus* (Linné)

Out of the total number of Kartabo birds twenty-one are migrants from North America, while the rest are more or less permanent residents, nesting in the district or in adjacent parts of the Colony. While it would seem easy to make this distinction between migrants and residents, as a matter of fact the line is rather loosely drawn. Some, such as the barn swallow, are unmistakably transients, living here in the tropics only during the season of northern cold. But others, such as the yellow warbler, while appearing in unusually large numbers during the season of migration, are also present throughout the year. If such a species should be found breeding it could be defined as migratory only to a limited degree. The egrets, while well known as migrants or as residents in parts of the United States, are resident in British Guiana.

The North American migrants include the following:

Golden Plover
Semipalmated Plover
Black-necked Stilt
Kingbird
Bank Swallow
Barn Swallow

Greater Yellowlegs
Lesser Yellowlegs
Solitary Sandpiper
Spotted Sandpiper
Upland Plover
Wilson's Snipe
Belted Kingfisher
Yellow-billed Cuckoo
Purple Martin
Yellow Warbler
Black-poll Warbler
Small-billed Water-thrush
Redstart
Summer Tanager
Bobolink

A vivid idea of the relative abundance of species of birds in the tropics as compared with the temperate zones is shown by the avifauna of New York State and that of the quarter of a square mile of jungle about Kartabo. The former, in actual area, is 180,000 times as large as our tropical field of research, and, according to Eaton, contains four hundred and eleven species of birds. For purposes of fair comparison it is necessary to eliminate from this list three exterminated species, six introduced species, and seventy-two accidental visitors which play no real part in the bird life of the State. This leaves three hundred and thirty New York birds as compared with four hundred and sixty-four at Kartabo. These two lists comprise twenty-four orders, of which seventeen are common to both localities, two are found only in New York, and five only at Kartabo.

The relative comparison of the orders is as follows:

The Birds of New York State and of Kartabo

	New York	Kartabo
Total Species	330	464
Migrants	262	21

Orders common to both Localities

	New York	Kartabo
Galliformes	3	6
Columbiformes	1	10
Ralliformes	8	10
Podicipidiformes	5	1
Lariformes	23	4
Charadriiformes	38	14
Gruiformes	1	6
Ardeiformes	9	11
Anseriformes	36	2
Pelicaniformes	4	2

Orders common to both localities—continued

Cathartiformes	1	4
Accipitriformes	17	28
Strigiformes	11	4
Coraciiformes	5	. 50
Cuculiformes	2	11
Piciformes	9	27
Passeriformes	148	241

Orders exclusively or dominantly Temperate

Podicipidiformes	Charadriiformes
Procellariiformes	Anseriformes
Alciformes	Strigiformes
Lariformes	

Orders exclusively or dominantly Tropical

Tinamiformes	Psittaciformes
Columbiformes	Coraciiformes
Gruiformes	Trogoniformes
Phoenicopteriformes	Cuculiformes
Cathartiformes	Scansores
Accipitriformes	Piciformes

Treating the Passeriformes from the point of view of families we find the following interesting line-up between the two localities:

Passeriformes of New York State and of Kartabo

	New York	Kartabo
Total Families	19	23
Total Species .	148	241

Families common to both Localities

Tyrannidae	9	48
Hirundinidae	6	8
Muscicapididae	3	1
Troglodytidae .	5	7
Mimidae .	3	2
Turdidae . .	8	4
Vireonidae	6	7
Mniotiltidae	38	10
Motacillidae	1	1

Families common to both localities—continued

Fringillidae	41	17
Tangaridae	2	22
Icteridae	9	12
Corvidae	5	1

Families exclusively or dominantly Temperate

Alaudidae	Sittidae
Bombycillidae	Paridae
Turdidae	Mniotiltidae
Laniidae	Fringillidae
Certhiidae	Corvidae

Families exclusively or dominantly Tropical

Conopophagidae	Dendrocolaptidae
Formicariidae	Tyrannidae
Rhamphocaeidae	Pipridae
Furnariidae	Cotingidae
Synallaxidae	Coerebidae
Xenopidae	Tanagridae

In future monographs, I shall treat in detail the actual annual and semi-annual breeders.

Of the strictly resident birds, an astonishingly large number are extremely local or sedentary. For example, if I wish to hear quadrille wrens, or at least see them, I am almost certain of doing so every month in the year by going to the Hacka Palm Swamp, in the vicinity of R11; from January to December the tiny chuckle-de-dee flycatcherlets, *Colopteryx galeatus macconnelli*, inhabit N12; crackling manakins, *Manacus manacus manacus*, never fail me in P15; and Guiana wrens, *Thryothorus griseigula*, are ever present tenants of the region about D8.

The nesting is in many cases almost as exact, and an egg of the Who-are-you, *Nyctidromus albicollis*, is unfailing, twice a year, in J12.

Except during the breeding season, one is impressed by the social instinct of the bird life, many species keeping in pure culture flocks, such as parrakeets, caciques and toucans, or in the never-failing, peripatetic, mixed flocks of ant-birds, tree-creepers and other small fry.

The point of view I have chosen to take up here in special detail

is the interrelationship of enemy and prey, concerning the two more primitive of the trio of animal activities.

The problem of avian enemies is an example of how even years of intensive concentration in the tropics result in only a skimming of the surface. One of the most evident facts is that birds have terrific competition to contend with. Again and again I have lost eggs or young by delaying a day, or even an hour or two, in collecting them. On the second visit they will be found broken or gone altogether, and yet in my examination of hundreds of stomachs of all classes of vertebrates I have found only ten species feeding on birds, one of which had devoured the eggs alone. Five of these were snakes, four hawks and one was a mammal. Even this list should rightly be cut down to six, as three of the snakes were feeding on our domestic chickens,—although this is very certain evidence of ornithopagous habits. Unquestionably I have missed many enemies.

My evidence as to the diet of birds is more positive, as the following list shows:

CLASSIFIED FOOD OF BIRDS

Springtails	*Chloronerpes flavigula*
Earth-worms	*Aramides cajanea*
Mollusks	*Creciscus viridis* *Hylopezus macularia* *Synallaxis guianensis* *Myiarchus ferox*
Sowbugs	*Tachyphonus rufus*
Small Crustaceans	*Theristicus caudatus* (several hundred)
Shrimps	*Butorides striata* *Cochlearius cochlearius* *Actitis macularia* *Pitangus sulphureus*
Crabs	*Butorides striata* *Actitis macularia* *Theristicus caudatus* *Tigrisoma lineatum* *Sclateria naevia* *Pitangus sulphureus* *Aramides cajanea* *Heliornis fulica* *Cochlearius cochlearius*

Classified food of birds—continued

Scorpions	*Dromococcyx pavoninus* *Pithys albifrons* *Campylorhamphus procurvoides*
Millipedes	*Crotophaga ani* *Erionotis amazonicus* *Formicarius moniliger crissalis* *Xiphorhynchus pardalotus* *Dendrocolaptes certhia*
Centipedes	*Leucopternis melanops* *Crotophaga ani* *Erionotis amazonicus* *Formicarius colma* *Hylopezus macularia* *Cyanocorax cayana*
Harvestmen	*Crotophaga ani* *Sclateria naevia*
Spiders	Sixty species of birds
Mites	Two species of birds
Orthoptera (total)	Seventy-eight species of birds
Grasshoppers	Forty-six species of birds
Roaches	Twenty-seven species of birds
Crickets	Five species of birds
Rhipipteryx	*Myrmoborus angustirostris*
Mole Crickets	*Butorides striata* *Crotophaga major*
Mantids	Eight species of birds
Neuroptera (total)	Five species of birds
Mantispid	*Dendrocincla fuliginosa*
Diptera	Twenty-one species of birds
Termites	*Ibycter americanus* *Chloronerpes flavigula* *Celeus hellmayri* *Picumnus buffoni undulatus* *Myrmopagis axillaris* *Myrmoderas ferruginea* *Hypocnemis cantator* *Myrmoborus angustirostris*

Classified food of birds—continued

	Formicarius colma *Hylopezus macularia* *Glyphorhynchus cuneatus* *Placostomus gumia* *Pipromorpha oleaginea* *Muscivora tyrannus* *Atticora fasciata* *Elaenea cristata whitelyi*
Hemiptera (total)	Forty-one species of birds
Cicadas	Ten species of birds
Reduviid	One species
Dragonflies	*Pitangus lictor* *Tachycineta albiventris* *Progne chalybea*
Damselfly	*Notharcus tectus*
Lepidoptera (total)	Thirty-six species (no butterflies)
Moths	*Falco rufigularis* *Lurocalis semitorquatus* *Jacamerops aurea* *Thamnophilus incertus* *Myiodynastes maculatus* *Progne chalybea* *Scotothorus olivaceus*
Lepidopterous Pupae	*Corythopis torquata anthoides*
Butterfly Eggs	*Myrmoderus ferruginea*
Caterpillars	Twenty-nine species of birds
Beetles	One hundred and forty species of birds
Cetonids and Metallic Beetles	Twenty-two species
Weevils	Forty-two species
Water Beetles	*Butorides striata*
Hymenoptera (total)	Ninety-five species of birds
Hymenoptera (general)	Twenty-three species
Wasps	Twelve species of birds
Bees	Eight species of birds
Ants	Fifty-eight species of birds

Classified food of birds—continued

Leaf-Cutting Ants (*Atta*)	*Myiarchus ferox*
Fish	*Ardea cocoi* *Phaetusa chloropoda* *Sterna superciliosa* *Cochlearius cochlearius* *Pitangus sulphureus* *Phalacrocorax nigrea* *Anhinga anhinga* *Chloroceryle inda*
Bufo marinus	*Urubitinga urubitinga*
Bufo guttatus	*Urubitinga urubitinga*
Unidentified Lizards	*Micrastur interstes* *Attila spadiceus spodiostethus* *Attila thamnophiloides* *Attila uropygialis*
Anolis	*Harpagus bidentatus*
Cnemidophorus	*Leucopternis melanops* *Hylopezus macularia*
Ameiva	*Leucopternis melanops* *Gampsonyx swainsoni*
Polychrus	*Elanoides furcatus*
Snake	*Pulsatrix perspicillata*
Rail	*Harpia harpyia*
Tanager (nestling)	*Elanoides forficatus yetupa*
Tangara violacea	*Falco rufigularis*
Chlorophanes spiza	*Falco albigularis*
Cyanerpes cyaneus	*Elanoides forficatus yetupa* (egg only) *Falco albigularis*
Unidentified Birds	*Asturina nitida* *Falco rufigularis*
Mouse	*Rupornis magnirostris* *Chondrohierax palliatus* *Ciccaba superciliaris macconnelli*
Bat	*Ciccaba huhula*
Monkey	*Thrasaetus harpyia* *Spizaetus tyrannus*
Three-toed Sloth	*Harpia harpyia*

In the quarter square mile of jungle under observation I have breeding records of two hundred and five species of birds, scattered throughout seven hundred and three separate records of eggs, young or breeding condition.

To the following list of the species I have added the months in each case and the number of times in which breeding has been observed in each month. I have followed Chubb in his "Birds of British Guiana" as to sequence and scientific names:

BREEDING RECORD OF KARTABO BIRDS

Tinamus major—March (7), April (17), May (7).
Crypturus soui—May (2).
Crypturus variegatus—March (3), April (5), May (3), June (4), July (3), September, October.
Crax nigra—March, April (3), August.
Penelope marail—July.
Penelope granti—March, April (2).
Ortalis motmot—May, August.
Odontophorus guianensis—April (2), May (3), June (2), August (2), September.
Columba speciosa—April (4), May.
Columba purpureotincta—May.
Chaemepelia griseola—August.
Chaemepelia talpacoti—March (3), April, September (3), November, December.
Leptoptila rufaxilla—March (2), April (5), May (5), September.
Leptoptila verrauxi—September.
Oreopelia montana—March, April (5), May (5), June (3).
Aramides cajanea cajanea—June.
Porzana albicollis—April to mid-July, fresh eggs.
Creciscus exilis—April, September.
Creciscus viridis—April 5–July 13, fresh eggs; June.
Phaethusa chloropoda—August, 3 month juv.
Jacana spinosa—January, June.
Eurypyga helias—April, May, June (2).
Psophia crepitans—March, April, August.
Theristicus caudatus—June.
Butorides striata—August.
Anhinga anhinga—June.
Ibycter ater—March.
Milvago chimachima—March, May.
Micrastur gilvicollis—April.
Leucopternis melanops—March.
Elanoides forficatus—March.
Chondrohierax palliatus—May.

Breeding record of birds—continued

Ictinia plumbea—March, April, August.
Ciccaba superciliaris—April.
Amazona dufresniana—March.
Pionus menstruus—June.
Pionus fuscus—March.
Pionites melanocephala—June.
Chloroceryle amazona—July.
Chloroceryle inda—May.
Chloroceryle a. aenea—July.
Momotus m. momota—April (2), May.
Nyctibius griseus—April, September (2).
Hydropsalis schomburghki—May.
Nyctidromus albicollis—March, April (3), May, August, September (4).
Caprimulgus nigrescens—March (2), April (5), May, June, July (2), September (4).
Chaetura brachyura—March.
Cypseloides fumigatus—June.
Phaethornis superciliosus—May, August, September, November.
Phaethornis ruber—March (2), September, October.
Campylopterus largipennis—May, September.
Thalurania furcata fissilis—March, April, May (2), July (2).
Anthrocothorax violicauda—May (3), July, August.
Polytmus chrysobranchus—May (2).
Topaza pella—March, April, May, July (4), August (3), September.
Heliothrix aurita—July.
Trogonurus collaris—April, May (2).
Trogon melanurus—May.
Trogon rufus—April.
Trogon s. strigilatus—March, April, June.
Trogon violaceus—May.
Piaya cayana—April, July, August, September.
Neomorphus rufipennis—June.
Dromococcyx pavoninus—May, June.
Crotophaga ani—February (2), March, April (2), June, September (3).
Capito niger—April.
Ramphastus monilis—March.
Ramphastus vitellinus—March, April, May.
Pteroglossus aracari—April (2), August.
Pteroglossus viridis—March.
Urogalba d. dea—September.
Galbula albirostris—May, August, September.
Bucco capensis—April, August.
Bucco macrorhynchus—May.
Monasa niger—July (2).
Chelidoptera tenebrosa—April (2), September.
Melanerpes rubrifrons—March, April.
Campephilus rubricollis—March, July.

Breeding record of birds—continued

Campephilus melanoleucus—March.
Picumnus undulatus—May.
Corythopis torquata anthoides—April, May (2), June.
Cymbilaimus lineatus—May, July.
Frederickena viridis—September.
Erionotis tristis—May.
Dysithamnus murinus—March (2), April, May (2), June, October.
Dysithamnus saturninus—April.
Thamnomanes glaucus—March (2), May.
Myrmopagis axillaris—April (3), June.
Poliolaema cinereiventris—April, June.
Poliolaema guttata—May, September.
Herpsilochmus sticturus—May.
Terenura spodioptila—May, June, August.
Rhamphocaenus albiventris—March, April, May, August, September (3).
Cercomacra tyrannina saturatior—November.
Manikup albifrons—March, April (2), May (2), June, September.
Anoplops rufigula—June, August.
Myrmornis torquata—August.
Sclateria naevia—June.
Sclateria leucostigma—May.
Myrmoderas ferrugineus—January, June.
Hypocnemis cantator—May, April, September.
Myrmoborus angustirostris—May, June.
Dichropogon poecilonota—July.
Stictomyrmornis naevius—March.
Formicarius colma—April, June.
Formicarius crissalis—May.
Grallaria brevicauda—April.
Hylopezus macularia macconnelli—April, May, June (4), July (3).
Sclerurus caudacutus—May.
Synallaxis guianensis—February, March, May, June, July (2).
Synallaxis cinnamomea—February, March.
Automolus turdinus macconnelli—March (2), June, August.
Automolus cervicalis—March, May.
Glyphorhynchus cuneatus simillimus—June (4), July (3), August, October, November (2).
Dendrocincla fuliginosa—April.
Xiphorhynchus sororius—March.
Campylorhampus procurvoides—March.
Dendrocolaptes plagosus—March, April, May.
Fluvicola pica—February, June.
Arundinicola leucocephala—April.
Placostomus griseiceps—May.
Placostomus saturatus—June, August.

Breeding record of birds—continued

Rhynchocylus sulphurescens examinatus—May, June.
Rhynchocyclus poliocephalus inquistor—September.
Todirostrum cinereum—February (3), May, June.
Todirostrum maculatum—March, June, September.
Perissotriccus ecaudatus miserabilis—May, September.
Colopteryx galeatus macconnelli—May (2).
Pipromorpha oleaginea macconnelli—March (2), April (3), May.
Ornithion pusillum—March (2).
Tyranniscus acer—April.
Elaenea pagana macconnelli—May, June, September.
Elainopsis guianensis—May, July.
Legatus albicollis—March, May.
Myiozetetes cayennensis—February, March, April, May, July.
Pitangus sulphuratus—January, February (2), March (3), April, May.
Pitangus lictor—February (2), March (2), May (2), September.
Megarhynchus pitangua—March.
Myiobius barbatus—March, May (3), June, July (2), October.
Myiarchus ferox—February.
Empidonomus varius parvirostris—May.
Tyrannus satrapa—March (4), April (5), May (4), September (2).
Muscivora tyrannus—March.
Pipra aureola—March.
Pipra erythrocephala—February, March, April, June.
Pipra leucocilla—March (2), May (3), July, December.
Pipra suavissima—March, April, May.
Piprites chlorion—May.
Corapipo gutturalis—March, May.
Chiromachearis manacus—March (3), July.
Scotothorus olivaceus—December.
Tityra cayana—March (2).
Lathria cinerea—March (2).
Laniocera hypophyrrha—May.
Lipangus simplex—September.
Attila spadiceus spodiostethus—March, May.
Phoenicocercus carnifex—January.
Cotinga cayana—September.
Xipholena punicea—March, June.
Querula purpurata—April (2).
Calvifrons calvus—June, September.
Tachycineta albiventris—April, September.
Progne chalybea—March (3), May (3), June, September.
Pheugopedius griseigula—May, June (2), October.
Troglodytes clarus—February, May.
Leucolepis arada—April, June (2), July.
Microcerculus bambla—May.
Planesticus fredericki—May (2), June.

Breeding record of birds—continued

Planesticus albiventer—April.
Planesticus phaeopygus—April (2), May (4), June.
Pachysylvia muscicapina—November.
Cyanocompsa rothschildi—January.
Oryzoborus brevirostris—March (2), June.
Sporophila bouvronides—May.
Sporophila lineola—April, June.
Sporophila gutturalis roraimae—March, May, June.
Microphila castaneiventris—March (4), April, June, July, September, November.
Microphila minuta—May.
Volatinia splendens—July.
Pitylus grossus—July.
Caryothraustes canadensis—March, November.
Coccopsis gularis—April, June, October.
Arremon taciturnus—March, April (2), May (4), June.
Coereba guianensis—March, September (2).
Dacnis cayana—September.
Cyanerpes cyaneus—May (2), June (3), July (2).
Cyanerpes caeruleus—May (2).
Tanagra cayennensis—June.
Tanagra violacea—March, April, May, September.
Tanagrella velia—December.
Tangara gyrola—June, August.
Tangara mexicana—April, May, September, December.
Thraupis episcopus—March (3), April (2), May (2), June, September, October.
Thraupis melanoptera—February, April (4), May (2).
Ramphocoelus carbo—March (5), April (4), May (5), August, October.
Lanio fulvus—April, May, June (2).
Tachyphonus rufus—March (3), April (2), May (2).
Ostinops decumanus—April (2).
Cacicus cela—March (3), April, September.
Cassidix oryzivora—March (3), April (2).
Leistes militaris—April, May, June, September, October.
Icterus xanthornus—February, June.
Melanopsar chrysocephalus—February (2), March (2), July.
Cyanocorax cayanus—March, April, May (3), June.

We thus have the following interesting distribution of breeding records through the twelve months; beginning with February as that is the first month of the Short Dry Season:

February	20	May	154
March	127	June	84
April	142	July	49

August	30	November	8
September	59	December	6
October	10	January	4

As shown in the accompanying chart, the climax of the breeding season is suddenly approximated in March, reaching its extreme in May, then descending rather abruptly and evenly to a low mark in August. September shows a second node of activity, indicating the second nesting season for a number of species which have already bred in March. The descent from September is abrupt and an exceedingly low mark at once reached, which descends even lower in the following three months, becoming almost nil in January.

THE ORDERS OF KARTABO BIRDS

Twenty-two orders of birds are represented in the research area, leaving three Guiana orders absent; these latter being hoatzins, petrels and horned screamers.

The following is a list of the orders, with the numbers of their respective species:

Order TINAMIFORMES

Family TINAMIDAE

Four species of these solitary birds are recorded, two common, one rare and one unique. All are medium-sized, brownish birds, feeding, nesting, and, with one exception, roosting on the jungle floor. A *Tinamus* and a *Crypturus* are among our chief sources of food, and I have records of one hundred and seventy-six shot either by ourselves or our Indian hunters. These were taken in or just outside of the Kartabo area, and yet the birds are as plentiful as they ever were. The remarkable life-history and breeding habits of the birds I am making the subject of a monograph which will follow this ecological paper. The birds are very protectively colored, as are the single eggs of *Crypturus*, but those of *Tinamus* contrast strongly with the dead leaves. The voice of *Tinamus* is a loud, penetrating, sweet whistle, a very characteristic jungle sound in the evening and on moonlit nights.

Order GALLIFORMES

Family CRACIDAE

Four species of jungle "turkeys" live within the quarter mile, none of them really common nor yet rare. Although pheasant-like

in superficial appearance, they are quite arboreal. The *Crax* and the two *Penelopes* are often shot for food. *Ortalis motmot* is wholly unlike all the other Galliformes in frequenting the haunts of man, coming close to the edge of our clearing at daybreak and calling in loud duets for many minutes. Flocks of the *Penelopes* in the jungle give utterance in the early morning to the most astonishing outcry of any creature I have ever heard. We have shot about sixty each of *Crax* and *Penelope* without diminishing their numbers.

Family ODONTOPHORIDAE

Two small leaf-colored partridges live on the jungle floor, one rarely seen, the other occasionally. They lay four white eggs, associate in small flocks, the voice is not loud, and their food consists chiefly of roaches and beetles. The Indians have brought in about twenty-five.

Order COLUMBIFORMES

Family COLUMBIDAE

Ten doves and pigeons range in size from the big *Lepidoenas speciosa* to the tiny ground doves *Chamaepelia*. The latter are found only in the clearings, and are very rare at Kartabo, not having yet established themselves. The larger jungle doves are solitary, with loud, booming voices heard as often at mid-day as in late afternoon. Many of them nest low down, from two to six feet from the ground.

Order RALLIFORMES

Family RALLIDAE

Nine species include such a diversity of forms as *Aramides, Porzana, Creciscus* and *Ionornis*. Only two *Creciscus* are other than rare, nesting in the coarse grass of clearings. Beetles, ants, small mollusks, earth-worms and crabs form their food.

Family HELIORNITHIDAE

The strange fin-foot, *Heliornis*, is occasionally seen and taken in the jungle creeks and among the mangroves. I have never found anything but spiders and crabs in its stomach. In general appearance and haunts this takes the place of grebes, which are exceedingly rare at Kartabo.

Order PODICIPIDIFORMES

Family PODICIPIDAE

Twice I have seen pied-billed grebes near the mouths of jungle creeks.

Order LARIFORMES

Family LARIDAE

Three terns and a skimmer comprise this family, *Phaetusa* being common, the others rare. I have seen two species of terns, besides feeding on fish, sharing a flight of termites with swifts, martins and flycatchers.

Order CHARADRIIFORMES

Family CHARADRIIDAE

The wading birds include four plovers, a curlew, a stilt, two yellow-shanks, two sandpipers, and three snipe, nine of which are migrants. The commonest of these is *Actitis,* healthy individuals of which are found every month in the year.

Family JACANIDAE

The jacana is very rare at Kartabo, this, together with ground doves and red-breasted starlings, being occasional strays from the Penal Settlement, three miles down river.

Order GRUIFORMES

Family ARAMIDAE

The limpkin is a rare bird at Kartabo, being much more common on the coast.

Family EURYPYGIDAE

The sun bittern is occasional, and rarely nests among the mangroves, depositing its single large egg on a depression on some horizontal limb. Only during its courtship is it other than a silent, inconspicuous bird. Like *Psophia,* it makes an ideal pet, quickly becoming tame and remaining close to the house.

Family PSOPHIDAE

The long-legged, hump-backed trumpeter, strange as to appearance and actions, and of unknown breeding habits, is almost common, being found in good-sized flocks in the jungle, and at the

first alarm flying well up into the high trees. Its strange, ventriloquial voice is only occasionally heard, and its food consists almost wholly of beetles and ants. We have had over fifty brought in for the table, and are seldom without a tame "Warracabra" walking about the compound.

Fig. 14. Young trumpeter, *Psophia crepitans* Linné.
Photograph by Paul G. Howes.

Family IBIDIDAE

Two ibises occur, one, *Theristicus*, a very rare straggler from the inland savannas, and *Harpiprion*, a fairly common feeder along shore. Their food is tiny crustaceans, crabs and worms.

Family CICONIIDAE

A March record of four wood ibises, *Mycteria*, flying slowly over the laboratory is the only occurrence of these birds.

Order ARDEIFORMES

Family ARDEIDAE

Eleven herons have been seen, some, as *Ardea cocoi*, *Cochlearius* and *Tigrisoma* not rare, others as the egret, *Casmerodius*, appearing only as a few stray young birds after the breeding season. Crabs and shrimps form much more of their food than fish, although I have found two puffers, *Colomesus*, in the stomach of a cocoi heron.

Order PHOENICOPTERIFORMES

Family PHOENICOPTERIDAE

Three flamingoes flying low overhead is the only record for Kartabo.

Order ANSERIFORMES

Family ANATIDAE

Kartabo is both too low down-river and too far above the coast to have many ducks. The splendid Muscovy duck, *Cairina*, is rarely observed, and *Dendrocygna* now and then perch among the mangroves.

Order PELICANIFORMES

Family PHALACROCORACIDAE

The little river cormorants are occasional, appearing now and then, perching on rocks out in the river and feeding on the armored catfish which crawl out over the mud-flats.

Family ANHINGIDAE

The identical words apply to the cosmopolitan snakebird, except that its food consists solely of small fish.

Order CATHARTIFORMES

Family CATHARTIDAE

Four vultures visit Kartabo. The black *Coragyps*, which is the most abundant on the coast, is unique here, a single individual having been seen. Offal will at once attract many yellow-headed vultures, and more rarely a red-head or a white king vulture.

Order ACCIPITRIFORMES

Family FALCONIDAE

Twenty-eight hawks and eagles form a splendid section of the Kartabo avifauna. *Leucopternis*, *Ictinia* and *Elanoides* are the commonest forms, but occur only in pairs or in families of three. A number do their hunting beneath the roof of the jungle, and often can be flushed from their prey on the ground.

Ibycter is a degenerate falcon which has taken to a vegetable diet and to utterances which outdo the macaws. The giants *Morphnus*, *Spizaetus* and *Thrasaëtus* are so rare that their occurrence is an event. All examined have been feeding on monkeys.

Except for the above-mentioned *Ibycter* and the low-soaring *Elanoides*, accipiters are not conspicuous and are never gregarious.

One more exception is *Pandion*. A fish-hawk is usually to be seen perched on a beacon off-shore, and often catches fish close to our stelling.

Order STRIGIFORMES

Family STRIGIDAE

Four owls occur, of which *Pulsatrix*; the spectacled, is far most often seen or heard. It kills snakes and birds, while *Ciccaba* prefers mice. The voice of any owl is a rare sound in the tropical jungle.

Order PSITTACIFORMES

Family PSITTACIDAE

The macaws, parrots and parrakeets number seventeen, of which six or eight are fairly common. *Ara* in pairs, *Amazona* in small, and *Touit* in large flocks, and all with loud discordant cries, are characteristic features of every-day life in the jungle. No matter how brilliant their coloring, the birds vanish when perching quietly among the lights and shadows of the foliage. All the nests found have been in hollow trees. Every one without exception is a vegetarian.

Order CORACIIFORMES

This hodge-podge comprises five diverse families,—kingfishers, motmots, goatsuckers, swifts and hummingbirds.

Family ALCEDINIDAE

Five autochthonous kingfishers and one migrant are found at Kartabo. Two specimens of our northern belted kingfisher have been secured, apparently southern stragglers. The other native species are about equally common, the larger *Megaceryle* haunting the open river, and the tiny *Chloroceryle* usually preferring the jungle creeks. All nest in the clay banks. Their notes are frequently heard and are proportionate to their size,—the big kingfisher springing a terrific rattle, and the small one uttering a sharp. high clicking.

Family MOMOTIDAE

The Guiana motmot sits in pairs in the jungle, attracting the ear by its basso-profundo notes, and the eye by its pendulum-jerking tail. It is almost common, but local, and feeds almost exclusively on coleoptera.

Family CAPRIMULGIDAE

Nine goatsuckers are found at Kartabo, three abundant vocally, and two in actual numbers. *Nyctidromus albicollis* and *Caprimulgus nigrescens* call about the laboratory every evening and morning throughout their bi-annual breeding seasons. From deep in the jungle there is heard the weird call of *Nyctibius*, the poor-me-one. This giant species is usually found up the creeks, where it deposits its egg on the top of rotten stumps. The two former lay their single egg in the bushy clearings near the laboratory at intervals of six months. Beetles and small moths form the principal food of goatsuckers hereabouts.

Family MICROPODIDAE

Eight swifts have been shot soaring over Kartabo, the commonest *Chaetura spinicauda*. The palm swift, *Reinarda*, and the feather-toed swift *Panyptila*, are decidedly rare, but occur every year, feeding high or low, according to the elevation of volant insect life.

Family TROCHILIDAE

Twenty-six hummingbirds have been taken out of the forty recorded from Guiana. Probably at least a dozen more remain

to be detected. Ten species are common, and the nests of five of them may be counted on along the vegetation of the river banks. I have obtained scores from one flowering tree, and individuals often have a very regular route, visiting the same spike of flowers or bushy inflorescence morning after morning at the same minute. Their courtship is exceedingly elaborate, and their voices, when raised in anger between battling males, are astonishingly loud.

Order TROGONES

Family TROGONIDAE

Five species of beautiful trogons occur, one of which is unique, and two others common. Their notes are loud and monotonous, they lay their eggs in termite nests, and are tame, stupid, very wonderfully colored birds. Beetles are easily first in their regimen, but they also take spiders, caterpillars, ants, grasshoppers, and cicadas in numbers.

Order CUCULIFORMES

Family CUCULIDAE

Eleven interesting birds form this assemblage, including the big rufous cuckoo, *Piaya,* the road-runner-like *Neomorphus,* the sedentary wife-sick, *Tapera,* and the two inimitable anis or old witch birds, *Crotophaga.* The latter are by far the most common, but all are far from rare. Much remains to be worked out in regard to the nesting habits of these cuckoos. *Tapera* and *Crotophaga* are inhabitants of clearings, while the rest are more jungle birds. The voices of these two are the only ones which are insistent enough to produce a deep impression on the memory. Insects of every conceivable group are eaten, but *Crotophaga* specializes in harvest-men, centipedes, squash bugs, millipedes, scorpions and other seemingly unpleasant items.

Order SCANSORES

Family CAPITONIDAE

One barbet represents its family, a brightly variegated bird, rather common in mid-jungle, often found with flocks of antbirds and warblers. Small berries form its food.

Family RAMPHASTIDAE

Five toucans live in the research area, three of which I have found breeding. Two are rare, three common. They haunt the tree-tops, and are often found in large flocks except during the breeding season. *Ramphastus vitellinus* is abundant, and their yelping voices are among the commonest of jungle sounds, and carry a mile or more.

Order PICIFORMES

Family GALBULIDAE

Five gorgeously colored jacamars live in the deep jungle, silently fly-catching from favorite perches. *Psilopornis albirostris*, the commonest species, breeds in termite nests.

Family BUCCONIDAE

Of this varied and interesting tropical family there are seven species at Kartabo. Three are fairly common, all jungle birds except *Chelidoptera*, which haunts clearings. The nests are made in stubs (*Bucco*), in holes in the jungle floor (*Monasa*), or in open, sandy soil (*Chelidoptera*). As a rule they are solitary, or found in pairs, usually silent, but with possibilities of extraordinarily varied notes.

Family PICIDAE

Fourteen woodpeckers hammer the trees in the research area, the great *Campephilus* sending a basso-profundo roll for a mile through the jungle, while the tiny *Picumnus* taps almost inaudibly. Several are constantly associated with flocks of antbirds and wood-hewers, two or three are found exclusively in and about the dead trees bordering old Indian clearings. They are all solitary, keep well up and in deep jungle are almost tree-top birds. As elsewhere, their voices are unmistakable, loud and penetrating.

Order PASSERIFORMES

This great group includes twenty-three families and two hundred and forty species, more than fifty percent of the whole Kartabo avifauna. They may be divided roughly into two divisions, first, twelve families, two of which are typically tropical, and the other ten absolutely so, and a second division of eleven families, most of which are as well or better developed in the temperate regions. In the first division there are one hundred and sixty-eight species, in

the second sixty-five. If we except Coerebidae and Tanagridae, the two divisions are aligned systematically as well as geographically —the remaining ten tropical families being also the first ten in a linear succession of Passeriform families.

There are ten species of migrants from the United States. All the remainder are residents within or at least just without the research area.

Family CONOPOPHAGIDAE

A single species, *Corythopis*, represents this small family in the quarter square mile of research area. It is found in deep jungle, where it *walks* about on the leaves, and nests rather commonly in the same situation. It feeds on beetles, spiders and caterpillars. It is a solitary bird and a silent one. Its coloring, like that of *Arremon taciturnus*, is that of a bird only recently adapted to life in the dimness of primitive jungles.

Family FORMICARIIDAE

Thirty-nine species of antbirds occur at Kartabo, out of the fifty-one which have been recorded from British Guiana. They are by far the commonest birds of the jungle and one can seldom walk more than a few yards before hearing some one of their characteristic call-notes.

All are strong, sturdy birds of more or less sombre coloring and in their variety of general structure and activity they show very remarkable radial adaptation, paralleling many diverse groups of temperate woods, such as flycatchers, shrikes, vireos, warblers, wrens, titmice, nuthatches and thrushes, while some genera strikingly resemble such oriental forms as pittas.

When not nesting on the ground or in low bushes, they are often found in flocks with other birds of their family as well as woodpeckers, woodhewers, tanagers and others. These flocks move slowly through the jungle, each species feeding in its particular manner. The name antbird is derived from a favorite habit of many of attending the battle-front fan of army ants, benefiting by the hosts of insects which rise in vain attempts to escape. *Manikup albifrons* is the antbird *par excellence*, and its loud chirp is almost always an indication of the exact location of one of the army ants' fans of activity.

Family RHAMPHOCAENIDAE

The syrinx of this long-tailed, gnat-catcher-like antbird *Rhamphocaenus*, first led me to suspect its isolated character and when once my attention was focussed, I soon realized that it was out of place in *Formicariidae*. Mr. de W. Miller independently came to the same conclusion. It flocks with the smaller antbirds and is far from rare, being as tame as are most unusually small, delicate birds.

Family FURNARIIDAE

Two of the strange oven-birds, *Sclerurus*, live at Kartabo, one not uncommon and occasionally breeding.

Family SYNALLAXIDAE

One of the most interesting families of Kartabo birds. In habits they are as diverse as cuckoos, and in structure very remarkable readaptations for a normal perching life, while some of them still retain the stiffened rectrices, and all are still garbed in the pattern and colors, of their woodhewer-like ancestor.

Two species of *Synallaxis* haunt the clearing, build huge nests of sticks and thorns, and call to one another with loud, varied notes. Their stiffened tails are used only in a wren-like fashion. Two *Automolus* and a *Philydor* live in the deep jungle, nesting in tunnels bored in earthern banks,—silent, furtive birds.

Family XENOPIDAE

The single species of *Xenops* composing this family is another aberrant woodhewer, specializing in the direction of nuthatches. It never uses its tail as a prop, but creeps about twigs and branches. The resemblance is also striking both in regard to the shape of the beak and the general pattern of the plumage. It is a common bird, and is usually found in the flocks of antbirds.

Family DENDROCOLAPTIDAE

These thirteen sturdy birds fill the place of woodpeckers in the mid-jungle. All nest in hollows, either in the tops of stumps, in narrow folds of tree buttresses, or in termite nests. They flock with other birds, the smaller with antbirds and the larger with jays and toucans. *Glyphorhynchus* is abundant and eight other species common. Their voices are loud and one of the most memorably characteristic jungle sounds, either loud, startling and woodpecker-like, or sweet, dropping cadenzas.

All climb up tree-trunks, using their stiffened rectrices, and all have a general similarity of livery,—rufous red backs, wings and tails, and pale striped heads, necks and underparts.

Although uniform in general activities, and method of progression, yet the diversity in the actual procuring of food is reflected in the remarkable variety of beaks, some short and wedge-shaped, others resembling awls, forceps, needles, and, as an extreme, very long, slender, sickle beaks, curving far round, recalling the female huia bird of New Zealand, or certain hummingbirds.

Family TYRANNIDAE

The dominant family of Passeriformes in Guiana, and, at least in number of species, at Kartabo. In the research area, forty-eight occur, compared with sixty-nine in the whole Colony. We may make a very rough division of the thirty-five genera into a smaller number which inhabit the clearings and open spaces, typified by *Fluvicola, Pitangus, Tyrannus,* and *Muscivora,* a still smaller group which haunt the tree-tops, glades, or at least keep to sunny places, such as the marvellous *Onychorhynchus coronatus.* All of these and the others of these two groups have touches or patches of brilliant color, but the majority of deep jungle Tyrannidae, like our wood pewees, are clad in sombre greens and browns. Among many of these are *Myobius,* and the many flat-bills and midget flycatchers.

As the food list shows, many flycatchers are almost wholly vegetarians, while some are experimenting in new organic fields, such as the kiskadee, *Pitangus,* which has developed very general piscivorous habits.

The voice of these birds is, as a rule, loud and persistent, with strong carrying power. Those of the clearings have a much greater assortment of tones than the jungle species.

Family PIPRIDAE

Eleven of these little jungle birds live here. The females are sombre green and sit on their two eggs in tiny cup nests only a few feet from the ground. Their mates in varied liveries of black, white, orange, and even mother-of-pearl, fly about the mid-jungle and utter strange calls, some even cracking their wing feathers. Five are common, most of the others occasional.

Family COTINGIDAE

Twenty spectacular species are found in the Kartabo jungle, each remarkable for voice or color or habit. *Tityra* and *Attila* are clearing birds nesting in hollow trees. The latter is the brain-fever bird of this region, its never-ending call of three or five notes persisting through the heat for many hours on end. *Lathria* inhabits the deepest swamps, where it whips out tones which carry over a mile. The calf-like call of *Calvifrons*, the gorgeous coloring of *Xipholena* and *Cotinga*, culminate in the pure white plumage, the fleshy tentacles and the marvellous notes of *Vavasouria*, the bellbird.

Almost all live in families, in the tops of the tallest trees, are probably more common than I ever know, and yield their nesting secrets only to the most persistent searching. One exception to this last was a female *Xipholena* who nested in a bamboo overhanging the laboratory.

Family HIRUNDINIDAE

Swallows are abundant along the rivers but almost never enter the deep jungle. Eight species occur, two of which are migrants. The Guiana martin, *Progne chalybea*, and the variegated swallow, *Iridoprocne*, are abundant, and ready to use any box which is put up on a pole over the water. *Atticora* is one of the most beautiful, common on jungle creeks, nesting in holes in the banks.

Family MUSCICAPIDAE

A single, rare gnat-catcher represents this family.

Family TROGLODYTIDAE

Seven wrens live in these tropics, one a species of Troglodytes, as friendly to man as elsewhere, the others living in deep jungle. All are characteristic as to tails, actions and bubbling music, while the quadrille bird, *Leucolepis*, is one of the most wonderful songsters of the jungle,—singing an ever-varied flute-like theme which is among the sweetest of all bird voices. Decidedly family birds, found in pairs, threes or fours.

Family MIMIDAE

This northern family has only two representatives, a *Mimus* and a *Donacobius*, the latter a bird of the coastal savannas which is only a straggler at Kartabo. Its amazing antics and remarkable duets make it an interesting type.

Family TURDIDAE

Four thrushes are found, one of them a migrant from the United States. At evening a very wide-spread jungle song is the surprisingly robin-like call of one of these species of *Turdus*. They live in isolated pairs in fairly deep jungle, and seem to remain in almost exactly the same locality throughout the year. The nests are placed on low mossy stumps.

Family VIREONIDAE

Seven vireos of three genera, *Vireo, Pachysylvia* and *Vireolanius* occur, all with actions and voices typical of their family.

Family MNIOTILTIDAE

Ten wood warblers, of which four are migrants. Many individuals of the yellow warbler *Dendroica*, however, are found throughout the year. *Granatellus* has been found only twice, and is rare everywhere.

Family MOTACILLIDAE

This decidedly northern family is represented by only a single, rare pipit.

Family FRINGILLIDAE

Of this rather more typically temperate family, seventeen species are found here. About half are clearing birds, the little *Oryzoborus* and *Sporophila* being abundant, most of them singing sweet, untropical songs. The three brightly-colored grosbeaks *Pitylus, Periporphyrus* and *Caryothraustes* are wholly jungle birds, almost always found with the antbird flocks.

Arremon is a solitary, silent, terrestrial jungle sparrow, too brightly colored to have been there many generations. It nests on the ground.

Only the clearing seed-eaters are found in flocks of their own kind.

Family COEREBIDAE

Seven honey-creepers, brightly colored, are all tree-top birds except *Coereba,* which is mid-jungle and clearing. Their nesting habits are varied, *Cyanerpes cyaneus* nesting over water and laying two black eggs. Five are common forms.

Fig. 15. Nest and eggs of *Thraupis Episcopus*, the abundant Blue Sakí Tanager of the research area
Photograph by John Tee-Van

Family TANAGRIDAE

Tanagers are well represented by twenty-two species. The most familiar birds of the clearing are two *Thraupis* and a *Ramphocelus*, the blue, palm, and silver-beaked tanagers, the latter the most abundant nesting bird in the area. The small euphonias, *Tanagra*, and the larger callistes, *Tangara*, are gregarious, haunt the tree-tops and congregate in jungle berry trees; *Cissopis* and *Lamprospiza* are solitary. No family shows more brilliant coloring, or is more decidedly an element of the tops of the jungle's tallest trees.

Family ICTERIDAE

These twelve species form an important element in the avifauna of Kartabo, and reflect the utmost variety to be found in any one family. The giant orioles, *Ostinops*, build their five-foot nests in

tall trees, and make the jungle ring with their courtship, and after the breeding season associate in flocks with toucans. The two brilliant *Cacicus* fashion shorter nests on lower trees, always in large colonies. *Cassidix* is parasitic upon all three. *Molothrus* is a stray from more open regions, and *Pseudoagelaeus* from the inland savannas. *Leistes* haunts every meadow with the habits of our red-winged blackbird, and a delightful flight song. *Melanospar* nests singly in palm trees. The bobolink is a rare migrant.

Family CORVIDAE

A single species represents this northern family, the beautiful lavender jay *Cyanocorax*, whose nesting habits are still a mystery, but which is usually seen in flocks with other birds of similar size, such as toucans and caciques.

Class MAMMALIA

This is a land where birds and insects are dominant. In the quarter square mile of research area, mammals are almost the least noticeable class. A stranger to this tropical region could wander for days through the jungle and catch only the most fleeting glimpse of accourie or deer or monkey. Vocally only the howling monkeys would ever distract his attention from the sounds of insects, amphibians and birds. In numbers, in variety of adaptations and habitat, in pattern, in coloration, in vocal ability, in general keenness of the senses, the Class of which we are members is hopelessly outclassed. Mollusks, and especially shelled snails, are small, obscure and very scarce at Kartabo, and yet in point of numbers they rank with mammals.

The total number of mammals taken or observed within the research area is seventy-three, a number exceeded by all other classes except amphibians. As far as I have been able to enumerate those from the entire Colony, this is about fifty-eight percent of the whole. Bats and the smaller rodents are very inadequately represented in the list, and future collecting will undoubtedly bring the total up to one hundred.

The mammals are divided into ten orders and twenty-seven families. The only order of living Eutheria not represented in the quarter square mile is Insectivora.

In size they range from the great cow-like tapir with a weight of hundreds of pounds, to the tiniest of insect-eating bats, which weigh a bare three grams.

As in the case of the birds, a comparison of the land and fresh-water mammals of New York State with those of a quarter of a square mile at Kartabo is well worth while. In New York, Miller has recorded eighty-one species, while I have listed seventy-three from the limited tropical area—an area which is $\frac{1}{180,000}$ of that of the temperate State.

Eleven orders are represented in the two localities, of which six are common to both, one is found only in New York, and four others occur at Kartabo alone. The relative number of species is as follows:

Orders of Mammals of New York State and of Kartabo

	New York	Kartabo
Marsupialia	1	6
Chiroptera	8	12
Carnivora	17	13
Rodentia	32	19
Artiodactyla	4	4
Cetacea	8	1
Insectivora	9	
Edentata		9
Sirenia		1
Primates		7
Perissodactyla		1

New York State was originally a country varied with open areas as well as forests, while Kartabo is almost wholly jungle or river. This difference is reflected in the relative adaptive radiation of the mammals of the two localities.

Environment Adaptations	New York Species	New York Percentage	Kartabo Species	Kartabo Percentage
Aquatic	3	4	7	9.5
Terrestrial	53	75	23	31.5
Arboreal	7	9.8	31	42.5
Aerial	8	11.2	12	16.5

If, instead of the above classification, we add to the strictly arboreal Kartabo species those mammals which are good climbers and spend much of their time in trees, we find that over 60 per cent. of the whole are more or less dependent on the jungle, while the

same test applied to the New York mammals shows only 11 per cent. arboreal.

As regards food, the seventy-three Kartabo mammals divide themselves into thirty-one which are herbivorous, thirty-one carnivorous, and eleven omnivorous.

In a relative summary at Kartabo, mammals (the group to which we ourselves belong), must be reckoned as seventh, preceded by birds, insects, fish, spiders, reptiles and amphibians. We realize that the age of reptiles and of giant mammals is past, and that the present is the age of man, insects and birds.

Many of the Kartabo mammals are nocturnal, almost all are dull-colored, and their senses of eye, ear and nostril are so keen that they are difficult of approach. The following notes which I have already published in the Zoological Society Bulletin on the mammals observed during the month of March, 1922, in the quarter square mile, will serve admirably as an introductory hint of tropical mammalian life as observed in the field.

"Only a few days after our arrival at the Station a herd of about forty wild peccaries, the collared species, came down within a hundred feet of the laboratory, and rooted under fallen logs and jungle floor debris in search of grubs and tubers. One of our party found a tree where a hacka was feeding on five successive days, and a pair of the animals on the sixth. When alarmed the hacka rushes down the trunk, paying no attention to the observer, no matter how close he may be standing, and dashes off through the jungle. A few days later a splendid black jaguarondi cat trotted past me, unhurried and in full view. I do almost no shooting within the quarter mile of area under observation, and hence let him go unharmed. So again, one day, sitting on the old stelling, when an ocelot came and sat down on a rock, we looked at one another and went our ways in peace. Three times during this month I started deer near the trail, and at least half a dozen of the big rodent agoutis have scampered away from their feast of fallen fruit with the commotion of a whole drove of animals. A jaguar has been about ever since our arrival. I found an agouti partly devoured, and the tracks of the big feline show him to be a full-grown animal.

"Every night three families of red howling monkeys roar across the river, and fresh-water dolphins come close to the shore at high tide and sigh as they exhale. Within our own area, there are at least two bands of howlers, two of cebus and one gang of beesa monkeys.

"Strangely enough we have not seen a single opossum this year, but they are here in numbers, and I occasionally hear them at night on the dining room table and running along the partitions of the bungalow. A tamandua anteater was found up a tree just back of the Station, and a great anteater eight feet in length was killed a short time before our arrival. In the stomach of the tamandua were two hundred thousand white ants or termites. Of course it would be impossible to count all these insects. Our method is to take ten cubic centimetres, and divide it into ten equal parts. In each of these there is an average of one hundred and twenty white ants, and when this divided into the accurately gauged mass of the remainder, the result of two hundred and three thousand insects is obtained. When we realize the terrible damage which these insects do to houses and furniture, it would seem the wise thing for tropical planters to encourage these long-tailed tamanduas as much as possible. With a flock of tamanduas to keep the termites down, and a colony of giant marine toads to attend to leaf-cutting ants, much more success would attend tropical agriculture.

"In the pits dug for frogs we have recently taken a spiny rat, a rodent normal in appearance until we rub its fur the wrong way, when the hairs of the back feel like the spines of a porcupine. We keep as pets the beautiful little brown and white mice which come to glean from our crumbs after dinner. Bats are abundant, and we have captured forty-three of the dusky blunt-nosed species in the bungalow, only six of which are males. Two other species have been shot, one new to us, and vampires fly around the tents every night, although no one has been bitten this year. My Indian hunter has brought in agoutis, a wild pig and many monkeys for food, and a beautiful twenty-six pound margay cat. The arboreal character of this animal is shown by its food, it having fed upon a cebus monkey, while the skin of the stomach was punctured in several places by spines of the tree porcupine.

"Thus during the month of March, without any especial search, in the course of tramps for materials dealing with special problems, we have seen twenty species of mammals, with a conservative estimate of one hundred and fifty individuals."

ENEMY AND PREY ECOLOGY

Fourteen species of vertebrates have been found feeding on mammals at Kartabo.

Enemy and prey ecology—continued

Three species of snakes feed on rodents and sloths.
Two owls feed on mice and bats.
Two hawks eat mice.
Three eagles devour monkeys and sloths.
Margay cat eats porcupines, cebus monkeys and sloths.
Ocelot and Jaguarondi eat spiny rats.
Coati eats opossums.

MAMMALIAN FOOD

Earthworms	*Nasua*
Spiders	*Nasua*
Scorpions	*Nasua*
Centipedes	*Nasua*
Roaches	Opossum
	Nasua
	Molossus
Long-Horn Grasshoppers	Opossum
	Nasua
Tree-Crickets	*Saimiri*
Beetles	Opossum
	Nasua
Ants	*Tamandua*
Moths	*Nasua*
Termites	*Molossus*
	Tamandua
Lizard Eggs	*Nasua*
Cophias flavescens	*Nasua*
Engystoma microps	*Nasua*
Small Opossum	*Nasua*
Tree Porcupine	Margay
Spiny Rat	Ocelot
3-toed Sloth	Margay
Cebus Monkey	Margay
Motmot	Margay
Leptodactylus pentadactylus	*Lutra*

Order MARSUPIALIA

Family DIDELPHIDAE

Out of ten or twelve Guiana opossums, six are found in the quarter square mile research area at Kartabo. The big *Didelphis*, almost exactly like our northern opossum, is a jungle scavenger. The tiny *Marmosa*, carrying sometimes ten young on her back, and the larger *Metachirus* come frequently into the pantry and laboratory. *Monodelphis* is much rarer. It nests in a small form on the ground

in grass, and feeds on beetles and roaches. The rarest of all is the *Chironectes* or water opossum, which I have seen twice but have not yet secured. All are nocturnal and, except the last, arboreal.

Order CHIROPTERA

A dozen species of bats have been recorded. Probably twice as many are present, but have not yet been secured.

Family EMBALLONURIDAE

The little river bats, *Rhynchiscus,* are common along the shore and up the creeks, roosting on the under side of tacubas and mangroves. The only other member of this family so far recorded is *Saccopteryx,* the rare sac-winged bat.

Family PHYLLOSTOMIDAE

Five species are found of which *Phyllostomus* is a very large, leaf-nosed species; the fruit-eating *Vampyrus* is the largest of all the bats occurring here; *Mesophylla* is a rare white jungle bat. I shot six out of eight, all roosting together beneath a large aroid leaf. Finally there are the very common *Glossophaga* and *Hemiderma.*

Family DESMODONTIDAE

The vampire, *Desmodus,* is not uncommon, and most of us have been bitten at one time or another, the bats entering the tents unless a lantern, turned low, is burning somewhere near.

Family FURIPTERIDAE

This flat-faced, small, delicate bat is not rare, and I have taken it in the jungle, up creeks, in the laboratory and in the tents. It is as devoid of expression as a King Charles spaniel, or a sloth.

Family MOLOSSIDAE

These are the common house bats of the Station, from twenty to sixty *Molossus* having to be ejected each year before we can work in peace. *Eumops* is rarer, but comes occasionally into the laboratory.

Order CARNIVORA

Family CANIDAE

Icticyon or hunting dog is the only member of this family found near the Station, and here it is probably a stray from the

inland savannas. A young specimen which was caught by an Indian and which he would not sell, a skull which I picked up, and a skin which was lost in transit are all the data we possess. One of my Indians has killed four near here.

Family PROCYONIDAE

Three mammals of this family make their homes here; *Procyon*, the crab-eating raccoon, is not rare along the river-banks, where its tracks reveal its nocturnal journeyings, and *Nasua*, the coati, comes through the jungle in pairs or families, tearing stumps to pieces, as arboreal as squirrels. At night the flash-light reveals the glowing eyes of the kinkajou, *Potos*, which is much commoner than is supposed.

Family MUSTELIDAE

Two giant weasels, *Tayra* and *Grison*, inhabit the research area, the former almost common, the latter rare. Both climb trees readily, and give forth a skunk-like odor. *Tayra* will rush down a trunk in one's very face to make its escape.

Two others live in the river, the rare giant *Pteronura*, sometimes six feet long, and the more common *Lutra mitis*, which is seen now and then, playing with its young among the mangroves.

Family FELIDAE

Five cats have been identified, and there is probably another small one which has evaded observation.

The jaguar, *Panthera*, occurs occasionally, and two have been seen on the same day near the laboratory. They kill cattle across the river, but like all other South American mammals, are quite harmless to man if not wounded or robbed of their cubs.

Felis couguar, the puma, has been recorded but once at Kartabo, but three miles down the river I have seen three, and two at Kalacoon. They are small animals and quite as harmless as jaguars.

The jaguarondi, *Herpailurus*, is a handsome, long-tailed black cat, weighing about fourteen pounds. It feeds on *Odontophorus* and large insects. The ocelot, *Leopardus*, is more common than the jaguarondi, but less often taken. I have found it usually when taking a domestic chicken. The last feline is the margay cat, *Margay*, which feeds on an unpalatable diet of spiny rats, spines and all, and is seen only rarely, usually by jack-light.

Order RODENTIA

Family HYDROCHAERIDAE

The capybara, *Hydrochaerus*, is common along the river shore, coming out at night and feeding on the succulent swamp plants. They do much damage to the Indians' crops, and are in turn hunted with dogs, and are delicious eating. The wild representative of the domestic guinea pig is found in the far interior of Guiana. The capybara is its five-foot representative. Two young are born and the immature have lived with us as pets.

Family DASYPROCTIDAE

The most abundant mammal in the research area is the agouti, *Dasyprocta*. My Indian hunters and I have killed one hundred and thirty-five for eating, and yet we hardly ever take a walk through the jungle without seeing or hearing one of these red-rumped rodents. There are one to three at a birth, usually two, and although they breed throughout the year, yet the usual season for births is at the beginning of the rains. They haunt certain trees when the berries or fruit are falling, and it is seldom that a Cuyuru palm or wild plum drop their fruit without attracting many agoutis and labbas. Agoutis seem especially subject to the attacks of bête rouge, and their ears are usually covered with hundreds. They weigh from five to ten pounds.

The larger, spotted labba or paca, with the misleading generic name of *Agouti*, is a much more rare animal, occasionally coming close to the laboratory. These animals often suffer from enormous warble fly maggots and a host of fleas. They weigh from twelve to fifteen pounds. One, or very rarely two, young are born, usually early in the long rainy season.

The rarest of this family is the small-tailed agouti, *Myoprocta*. At Kalacoon my Indian once brought in a young animal, and at Kartabo one adult has been taken. As with spider monkeys, the Essequibo seems to be the usual barrier for them, as they are not rare on the east bank, but only occur as strays farther to the west.

Family ERETHIZONTIDAE

The tree porcupine, *Coendou*, is probably more common than we realize, but its nocturnal, arboreal habits prevent its being often found. When it blunders into an Indian's benab or into the pantry it shows no fear upon being discovered, but proceeds to seek for

edibles, knowing that no ordinary assailant dares touch it. It has an overpowering odor, especially before it becomes accustomed to captivity.

Family OCTODONTIDAE

Two spiny rats have been taken rather commonly, *Echimys* and *Proechimys*. They are strictly jungle animals, but are also found commonly on the small islands offshore. They often fall into the pits we dig at the sides of the trails. They are fifteen to eighteen inches long, and weigh less than a pound.

Family MURIDAE

The common house mouse, *Mus*, and rat, *Rattus*, have both been taken at Kartabo, the former twice, the latter once, strays from civilization down-river, but neither has obtained a foot-hold.

Family SIGMODONTIDAE

Eight species of jungle mice and rats have been taken, and many more probably await discovery. These are one *Nectomys*, a common water rat, more common on islands than the mainland, three *Oecomys*, one of which is a new species, a spiny mouse, *Neacomys*, and three *Oryzomys*.

In several of the mice I have found two or three the regular number of young in a litter, a most interesting reduction in number compared with northern species, and comparable with the reduction of the number of eggs in many tropical birds.

Family SCIURIDAE

Two members of this typically northern family occur here, a very rare dwarf squirrel, *Sciurillus;* and a common olive brown squirrel, *Guerlinguetus*, which in size, actions and voice recalls our northern red squirrel, It is one of the noisiest mammals of the jungle, and the only one which dares to remain and scold after it has detected our presence.

Family BRACHYPODIDAE

The three-toed sloth, *Bradypus*, is not common when searched for, yet we have had several dozen during the years of occupancy, and they are probably much more numerous than we imagine. They are good swimmers and I have records of eleven crossing the rivers. I have written a monograph of this species, which will follow this ecological account of Kartabo.

Fig. 16. The Three-toed Sloth, *Bradypus*
Photograph by William Beebe

The two-toed sloth *Choloepus* is a much rarer inhabitant of the jungle hereabouts. Sloths are of course wholly arboreal, they are solitary and feed on the leaves of only a very few species of trees.

Family MYRMECOPHAGIDAE

The three ant-eaters form a remarkable triumvirate of mammals specialized for a single type of food. The great antbear *Myrmecophaga* is terrestrial, solitary and rare, being seen only once in a great while. I have sent three live ones up north, the last of which we secured after a long fight from boat and shore. It reaches a length of nine feet over all, and is wholly terrestrial.

The tamandua, with an identical generic name, is much more common, as we have secured about fifteen specimens. It is of medium size, weighs eleven to thirteen pounds and is arboreal, feeding both in the trees and on the ground. The last one examined

contained about 50,000 ants and termites, the proportion being about five of the former to one of the latter.

Cyclopes, the rare silky anteater, has been recorded only twice, and captured once. Small, nocturnal, arboreal, it may be more numerous than we know.

Family DASYPODIDAE

Four species of armadillos live in the quarter mile of research area, the giant armadillo, *Tabassous unicinctus*, which I have seen three times, but secured only twice. An adult measured four feet, six and a half inches, and weighed seventy pounds. The nine-banded armadillo *Dasypus* is less common than the eight-banded one, *Tatu*, whose holes are seen here and there in the jungle. As rare as the giant species is the smallest *Tatoua* of which only two live specimens have been recorded. Jungle scavengers, living alone, and coming out at dark, armadillos are seen only when one sits quietly in some trail.

Order PRIMATES

Family CALLITRICHIDAE

Like tailed agoutis, marmosets, *Cercopithecus*, are rare west of the Essequibo. Five records at Kalacoon and Kartabo are all I have, all in moderately low jungle, all tame, yet scolding loudly.

Family CEBIDAE

Six species of monkeys occur at Kartabo. Red howling monkeys, *Alouatta*, are the most abundant. About seventy-five have been killed for specimens and for eating, and yet in 1924 they were more numerous than ever, nine separate bands being within hearing of the Station. The roaring chorus is the loudest, most awesome and most remarkable of all jungle sounds. They favor high trees in swampy jungle. The white-headed saki or beesa, *Pithecia*, ranks third in numbers and lives in dry jungle. They are silent and only a faint cough reveals their presence. *Saimiri* or squirrel monkeys go in large bands but are very irregular, being common some years and almost absent others. A single specimen of *Saimiri cassaquiarensis* is probably a stray from the Brazilian frontier. The spider monkey, *Ateleus*, is rare west of the Essequibo, only two having been observed. *Cebus*, the ring-tailed capuchin, is the commonest monkey next to the howlers, going in large gangs, noisy and quite

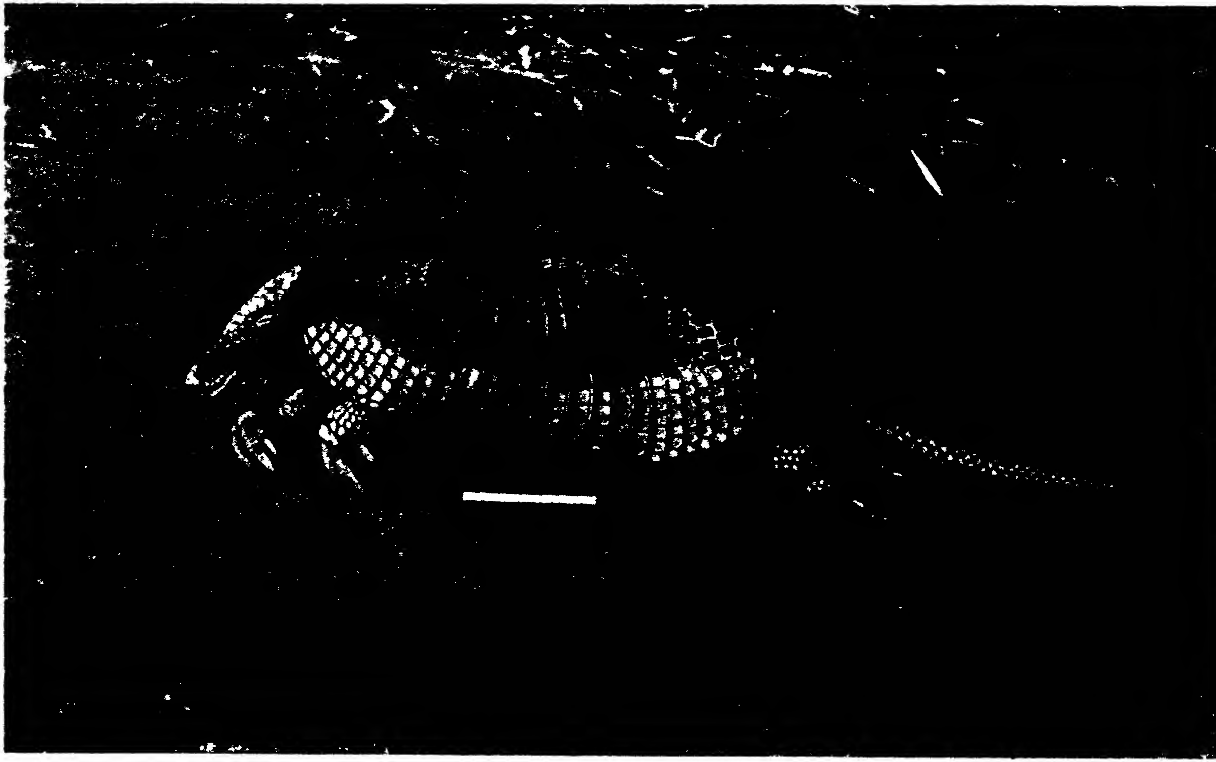

Fig. 17 Giant Armadillo; a rare creature and one of the most difficult to keep alive.
Photograph by John Tee-Van.

fearless. About sixty have been collected, to no appreciable extent diminishing their numbers.

Order ARTIODACTYLA

Family TAYASSUIDAE

Two peccaries are found here, both rather surprisingly being new subspecies. The big white-lipped *Tayassu pecari beebei* is rather rare, but found in large herds when it does occur. The more common collared peccary, *Pecari tajacu macrocephalus*, goes in pairs, families or small herds, and not rarely occurs close to the compound of the laboratory. We have not found them dangerous unless wounded. About forty-five have been killed for specimens and food.

Family CERVIDAE

Two deer, *Mazama*, a large red brocket and a smaller brown one are found, the latter being much more common than the red deer, the proportion shot being about ten to one. They are both small, as deer go, and wholly jungle animals, solitary, or the doe with one fawn.

Order PERISSODACTYLA

Family TAPIRIDAE

The bush cow or tapir, *Tapirus*, is a rare animal in the research area. About one each year is killed and I come across tracks now and then in the deeper parts of the swamps. On February 29th, 1924, a large one was shot close to the laboratory. They are usually found in pairs.

Order SIRENIA

Family TRICHECHIDAE

Twice among the mangroves I have seen manatees, *Trichechus*, and they are not uncommon in the shallows near the creeks across the Mazaruni River. I have taken no specimens since leaving Kalacoon. Near the coast they are numerous, and breed in the Botanical Gardens at Georgetown.

Order ODONTOCETI

Family PLATANISTIDAE

Fresh-water dolphins, *Inia*, are seen on an average of once a week, rolling past as they go up-river, or milling around, feeding in

front of the laboratory. In the shallows between the islands across the Mazaruni, as many as a dozen, old and young, have been seen. Usually from two to six are seen together. The fishermen now and then catch them in their nets. In spite of utmost efforts I have been unable to obtain a specimen.

VII—HISTORY OF KARTABO AND BARTICA DISTRICT

Almost four hundred years ago the fable of El Dorado was credited all over Europe, and created great excitement and a thirst for adventure among all classes of people. This wonderful city of gold was supposed to be located in Guiana, which was, it was said, an empire not inferior to those of Mexico and Peru, and such men as Raleigh formed magnificent conceptions of the civilization to be found beyond the barriers of jungle.

The fabulous city was first known as Manoa, but a Spaniard named Martinez, who claimed to have been there, called it El Dorado, for, he said, on the occasion of a feast the Emperor and all his captains, having first been rubbed with balsam oil, were then covered with gold ground into a fine powder, "until they be all shining from the foot to the head."

The wealth of Guiana was not the only marvel reputed to be found there. The tribe of Amazons, and the headless people whose faces were on their breasts, and the two-fingered negroes were some of the wonders of the country, according to the old tales.

When Columbus made his third voyage to the New World in 1498, he saw the distant northerly coast of Guiana but did not land there. Throughout the 16th century adventurers sought for Guiana, and of course more particularly for El Dorado. Men of all nations tried to be the first to reach the marvellous city where even the most common articles were made of purest gold.

In 1595 Sir Walter Raleigh made his first voyage of exploration up the Orinoco, concerning which he wrote "The Discoverie of Guiana," best of all Elizabethan narratives of adventure, but which was received with incredulity. In 1617 he made a second voyage thither,—a voyage which was a series of disasters.

While Spanish, English and French were eagerly searching for gold, the Dutch were busy trying to build up trade with Guiana. As early as 1580 they had established a settlement on the Pomeroon River, called Nova Zeelandia, and a similar post on Abary Creek,

known as Nibie, or Bush-rope Town. After some years roving bands of Spaniards made the Pomeroon settlement untenable; the inhabitants retired into the interior and went to the point where the Cuyuni River flows into the Mazaruni, just before the latter joins the Essequibo. There they established their headquarters on a tiny island opposite Kartabo Point, which they called Kyk-over-al, because of the wide view it commanded.

This is the earliest settlement in Guiana of which anything remains. When these first settlers came they found there the ruins of a small Portuguese fort, the history of which was unknown even in those days and has remained so.

For a hundred and twenty-four years this dot of land at the confluence of three great rivers was the seat of government of the Dutch colony of Essequibo, which included the extensive region between the Abary and the Orinoco. At first it was chiefly a trading post, where axes, knives, beads and trinkets were bartered with the Indians in exchange for cotton, anatto dye, hammocks, balsam, copaiba and tobacco.

In 1616, soon after Kyk-over-al was settled and christened, this tiny struggling colony was so fortunate as to acquire a man of authority and foresight to direct its destinies. This man was Gromweagle, a Dutchman who had served under the Spanish in various Orinoco expeditions, and had thus acquired so great a liking for Guiana adventures that he sought employment in that part of the world from his own countrymen. He was sent out from Zeeland with three ships, "and was the first man who took firm footing on Guiana by the good liking of his neighbors, whose humours the gentleman perfectly understood."

He rebuilt and strengthened the fort on Kyk-over-al and adopted it as his stronghold. During his time the colony flourished; he was sufficiently wise to adopt a friendly attitude towards all colonists in this part of the world, even carrying this radical policy so far as to trade with the Spanish and English. This, at a time when Dutch, French, Spanish and English were at each others' throats over the question of colonization, and jealousy and suspicion were almost universal among them, must have been a striking phenomenon.

In 1621, the Dutch West India Company was incorporated, and immediately began the introduction of negro slaves. Labor was naturally the crying need of the colonists, for though the land was fertile, the enormous amount of toil required to prepare the jungle

for cultivation needed many more men than had yet been tempted to come from Europe. The climate too, was a serious drawback to a white man's attempts at field labor, and its deleterious effects were not diminished by the quantities of alcoholic refreshment which were considered necessary to repel the dreaded fever. It had been found impossible to persuade the neighboring Indians to look with favor upon honest toil, so the momentous step was taken of importing African slaves.

Three years after this a regular garrison with a Commandeur was sent to Kyk-over-al, which thus became army headquarters as well as trading-centre and prison. Looking to-day at the dimensions of the island, it is hard to believe the records which state that at one time there were more than two hundred soldiers quartered in this small area. They must all have been slaves to the recently discovered vice of smoking, for at the present time it is possible at low tide to retrieve vast numbers of clay pipes from the mud under the ruined walls of the fort. Other relics are there too,—lead bullets and iron cannon-balls, to recall the purpose of this fort in a time of alarums and excursions, fragments of old pottery from the feasts of bush-meat that these sturdy old pioneers enjoyed, and now and then a bright little Dutch bead brought from the far-off Netherlands to tempt the dark and taciturn Indian to part with his small store of cotton or tobacco. Of the fort itself, there remains the archway built of narrow bricks also imported from the mother-country; staunchly fashioned, it still stands, resisting the creeping jungle fingers that seek to pull it down, but the walls, to whose enclosure it once gave access, have crumbled or been carried away to furnish building material elsewhere.

Dutch cultivation spread up the Essequibo, and less extensively up the Mazaruni and Cuyuni. At this time most of the pioneers' efforts were directed toward establishing plantations in the interior, and the subjugation of the jungle went slowly and painfully on.

In the meantime other parts of Guiana were settled. A Dutch colony on the Berbice, English ones on the Surinam and elsewhere, and scattered French settlers on the Cayenne. Up to the beginning of the 19th century Guiana colonies went through a dizzy succession of changes in ownership; British, Dutch and French captured, surrendered and recaptured, while the bickerings between the West India Company and the colonists' Court of Policy were endlessly complicated.

In 1666, an English expedition from Barbados captured Kyk-over-al, but in a few months the English who were left to guard the settlements of the Essequibo district were reduced to thirteen men. They had suffered much hardship through counter-attacks and lack of supplies and were soon forced to surrender to the Dutch.

In 1670, Hendrik Rol was in charge at Kyk-over-al, and during the next few years the West India Company had four large plantations near-by. There was one called Vryheid where Bartica now stands, those of Duinenberg and Fortuin near the present site of Kalacoon House, and Poelwyck on Caria Island.

In 1708, a French privateer under Captain Anthony Ferry sailed up the Essequibo, burning and plundering such settlements as he encountered. Having reached Vryheid, he successfully raided it and the neighboring plantations. The planters took refuge at Kyk-over-al where the Commandeur, one Van Der Heyden, refused to give battle on their behalf, since he had but fifty men to the privateer's three hundred. Ferry sent an officer with a flag of truce to demand ransom, threatening to burn all the estates if this were refused. Van Der Heyden capitulated and agreed to pay fifty thousand florins in slaves, provisions and cash, if Ferry would go without causing further damage.

Richard Schomburgk, who travelled extensively in the interior of Guiana in 1840–1844, gives an interesting account of the origin of the settlement on Kartabo Point, where he went to recruit hands for his inland journey. He says, "The evening having become unusually dark and stormy, we determined to spend the night at Cartabo and return to Bartika first thing on the following morning. The obliging and friendly coloured folk supplied us with hammocks and, though not asked, cleared out a house for our night's quarters, the paddlers preferring the benches and ground spaces. We were up and about by break of day, which gave me an opportunity of having a look over the whole settlement and its occupants.

"The large number of coloured people who inhabit the Essequibo and Mazaruni are mostly descendants of Europeans, negroes and Indians; all belong to the Established Church, and generally stand on a higher plane of civilization than the surrounding Indians. They are the purveyors for the most part of the dried fish supplied to the city, just as they are the builders of the punts, lighters and corials used on the estates, in the manufacture of which they develop unusual

skill. In not too stormy weather, one can even trust oneself at sea in these boats. There is an historical reason for the settlement of this isolated coloured colony here at the junction of three rivers. In the year 1738 some forty odd creole slaves on the possessions of the Dutch Company banded themselves together, secretly left their estates and fled to the Cuyuni where they settled on an island that is still called Creole Island, cultivated some land, and at the same time entrenched themselves fairly strongly. The news naturally had a disquieting effect upon the Governor and plantation-owners, as it was feared that the example taken might be repeatedly followed.

These fears were further increased when the runaways, in their presumption, went so far as to inform the Governor through some Indians that if he wanted to make slaves of them again he must come and fetch them, not only with the whole of his forces but with those of Holland as well, and that they were accordingly awaiting him with confidence in the firm conviction of seeing the attempt on his part completely frustrated. The Governor recognized their advantageous position and at the same time all the difficulties to be encountered in the way of successful attack; he therefore deemed it far better to conclude a favourable treaty than to put to a test the uncertain fortunes of war. A certain Peter Tollenaar, a mulatto, was despatched, unarmed, for the purpose of discussing peace-terms with them on the following lines,—if they did not extend their raids into the Colony but worked every second month for it, and at the same time gave assurance not to entice away any more slaves, the Governor would give them and their descendants their freedom. Peter Tollenaar was successful in his efforts on behalf of peace and from that time up to Emancipation this free and coloured population continued its existence. To prevent their children falling back into slavery, the men were at first allowed to marry only free Indian women."

For some years there had been a gradual migration toward the coast-lands, for though the interior was far more healthy, the difficulty of combating the jungle, together with the realization that the soil of the coast was better suited to the raising of sugar cane, had determined many planters to brave the miasmas and malarias of the littoral regions. In 1740, under Governor Storm Van Gravesand the seat of government was removed to Fort Island near the mouth of the Essequibo, and the Demerara region began to be more thickly settled. Those of the planters who had not preceded the

Government's move now followed it, and Kyk-over-al was abandoned forever.

Although the Dutch had gone, they left behind more than a deserted fort and a few plantation buildings. That inevitable result of slavery, the half-breed, was present in numbers. In the earlier times the planters had bought Indian slaves from the Caribs, who raided the villages of other tribes and trafficked in their captives. Down to the end of the 18th century Indian slaves were still held, though the trade was prohibited. Thus in every settlement there were the children of Indian women and white men as well as the offspring of African and white, and, in smaller numbers, the results of Indian and negro matings, despite the Indians' dislike of the blacks.

The majority of these people stayed in the jungle after the Europeans had left, and since most of them were totally lacking in the energy which they might have inherited on the paternal side, they relapsed at once into indolence, and did only as much as was necessary for bare existence. Soon the encroaching forest was quietly reclaiming its own, and to-day the gaping archway of Kyk-over-al, leading to nothing but weeds, seems symbolical of the Dutch occupation of this region and its human residue.

There was practically no Government control of this upper region; there was no interest in it, unless runaway slaves were to be hunted, and they seldom got so far as Kartabo, for the Indians were subsidized by the planters to hunt them down. The locality became a sort of refuge for the destitute and for law-breakers, and presently a word was coined to designate these people of three bloods and no race. On the coast they were carelessly referred to as the ones who lived "above yonder," and this becoming corrupted to "boviander" has come to be the name of a people good-natured, shiftless, ignorant and easy prey to disease.

Our nearest neighbor at Kartabo, a boviander woman with kinky hair and coffee-colored skin, used to tell us proudly that her great-grandfather was Governor Van Der Heyden, and that the great tree which overhung our bathing-beach was used for a gallows in the days of which her grandmother had told her.

The strange combination of races resulting in the boirianders, and their proximity to the native Indian tribes has produced many interesting and romantic tales, and it is a pity that so many must have been lost through lack of some one to record them.

A reference to an island that was very likely Kyk-over-al is quoted from an article by Mr. James Rodway in Timehri of 1896; "The Indians did not always agree with the bovianders, and in 1805 Postholder Linau was sent up the Essequibo to reconcile the parties in dispute. He met with an Arawak who had abandoned his home because the mulattoes had frightened him with a report that the Acawoios and Macousis were coming down to murder them all. He found the bovianders from Essequibo, Massaruni and Cuyuni congregated on a small island as they said for defense against the Indians."

Bartica was chosen as the site for a mission station in 1829, and this project appears to have flourished for some years, as Schomburgk wrote of it in glowing terms after he visited it in 1841. He particularly described the school for Indian children, whose parents emerged from the jungle once a week on the day when they were permitted by the missionary to visit their offspring. However, when im Thurn was there in 1878, it was abandoned and in ruins.

On the Mazaruni River, on the opposite side from Bartica and a few miles above it, the bank is steep,—almost cliff-like. Here there once stood the residence of a Post-holder, but in 1841 the abandoned house was pulled down and the Penal Settlement was built. This establishment has never been abandoned for lack of patronage, and the fact that it occupies one of the most beautiful and healthy spots in the Colony might almost be regarded as an inducement to crime. The prisoners are mostly negroes and "colored" men, a few Hindus, and rarely a wretched Indian, who neither comprehends the nature of his crime nor the punishment for it. The state of mind of such a captive affords a striking contrast to the equanimity, verging on positive enjoyment, with which most of his colored fellow-inmates regard a sojourn at this spot.

About 1881 gold was discovered in the upper Mazaruni district, and in the wild enthusiasm roused by this find, it almost seemed as though the long-sought El Dorado had been reached at last. Bartica, originally settled as a mission, became the boom town of the gold rush, which has steadily grown in the succeeding years. It was still further augmented not long ago when the discovery of diamonds was made in the same region, and the reports of the housing conditions in Bartica equal the horrors of the slums, though the climate renders sleeping in the streets a pleasure rather than a hardship.

At present the only means of reaching the gold and diamond

fields is by water, and at all hours of day or night one may hear from Kartabo Point the chanteys of the "pork-knockers," as they paddle up the wide river to their tiny claims deep in the jungle. Plans for building a railroad to open up this district are being considered and some day this portion of primitive forest will be as well known as the sugar estates of the coast.

SUMMARY

No fossil remains of extinct animals occur near Kartabo, and no evidences of prehistoric man, except for a single, very beautiful stone axe, which was dug up within two hundred yards of the Research Station.

To-day we are the last white settlement up-river. Three miles below on the north bank of the Mazaruni, is H.M.P.S. just visible as a group of low buildings, and on the south bank the red roof of Kalacoon appears above the jungle, occupied as the Research Station in 1916 (vide Tropical Wild Life, Z.S. 1917). Above us on the Mazaruni are a few scattered benabs of half-breeds or boviandeers, and of Akawai Indians. Boat-loads of blacks pass up-river in search of gold and diamonds, while a small Government launch plies once a week up the Cuyuni to the foot of the first falls. Connection with the outside world is through small Government steamers which make three weekly trips between Georgetown and the Penal Settlement.

With these exceptions, the race of man exists only by hearsay in these happy regions.

THE VARIEGATED TINAMOU[1]

Crypturus variegatus variegatus (Gmelin)

BY WILLIAM BEEBE

Contributions to the Life History and Anatomy of the Birds of Kartabo, Bartica District British Guiana

Besides the life history, my object in this résumé of certain characters of the birds of Kartabo, is to present a study of the hyoid and of the syrinx, combined and correlated with the voice itself. I have supplemented this with other characters which Ridgway and Chubb have necessarily been compelled to give inaccurately from dried skins, such as total length, or have quite omitted, as extent, weight, tongue, hyoid, the fresh, unshrunk tarsus, etc.

THE VARIEGATED TINAMOU

Crypturus variegatus variegatus (Gmelin)

(Plates A–B; Figs. 18–22 incl.)

Type Description: *Tetrao variegatus,* Gmelin, Syst. Nat. I. 1788, p. 768 (Gujana).

Names: *Colonial;* Small Maam, Mamoo Swagger. *Akawai;* Orri-orri.

Field Characters: Medium-sized tinamou; head dark; upper parts, wings and sides black, narrowly barred with buff; neck all around and breast chestnut; chin, throat and abdomen white.

Haunts: Floor of the jungle, rarely coming to the bank of the rivers, and never into clearings. I have found them both in low, almost swampy spots, and on high, dry, sandy ridges.

Abundance: Second to *Tinamus major,* and away from the rivers probably exceeding it in numbers. Within the research zone of a quarter square mile at Kartabo, I have counted, with no duplication, the calls of sixteen individuals in the course of an hour's continuous walk.

Home Range: By means of slight peculiarities in the call-notes, I have been able in two instances, to locate with certainty the home range of the Variegated Tinamou. One bird, a female as it ulti-

[1] Contribution, Department of Tropical Research No. 191.

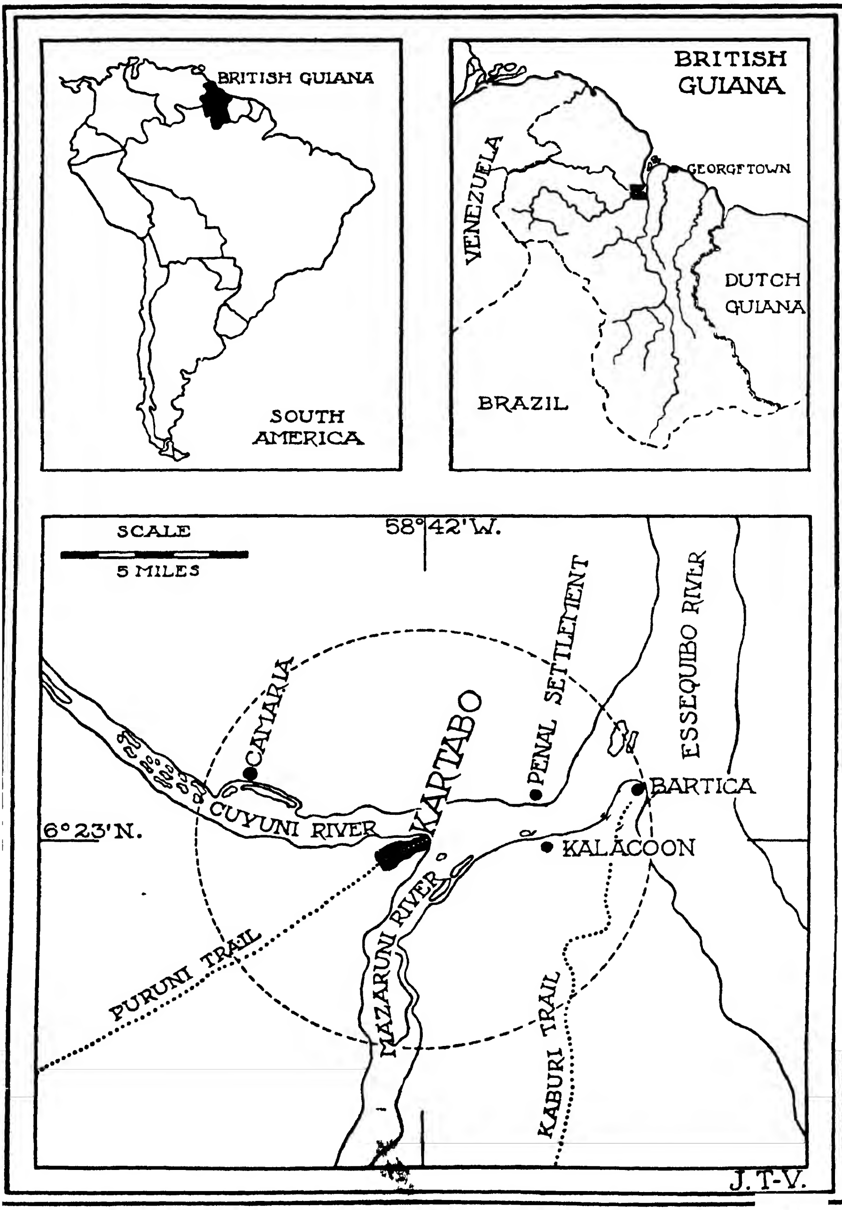

Plate A. British Guiana Tropical Research Station of the New York Zoological Society. The circle represents a radius of six miles.

mately proved, was always to be found in one of two small snarls of lianas and underbrush within the hundred foot square of AA_{26}. Any time during the night the bird could be flushed from this spot. In the morning about 5:30 she began calling, timidly at first, then with more assurance. As it grew light she left her retreat and moved slowly west across one of our trails and then turned south to several trees with fallen fruit. Here the calling ceased for about half an hour and then recommenced as she retraced her steps, turned west again and went on until I lost her in the maze of thick jungle. Her last call was given about seven o'clock. During the period of a full month she followed this identical routine every one of the eighteen mornings on which I trailed her, with a single change to a new feeding ground when the supply from the first gave out. On five evenings I found her back in the brush pile, when she began a new period of calling, usually beginning about 5:15 and continuing intermittently until nearly seven o'clock. A third period is often marked among these birds, from nine to ten P.M.

Geographic Distribution: This form of tinamou extends to Venezuela and north Brazil.

Sociability: These birds are decidedly solitary, found together only by accident for an hour or two when feeding under the same tree, and for little longer when the mating takes place.

Specific Individuality: The partridge-like gait is like that of other tinamou; the flight is sudden, noisy and direct. It is wary even when never shot at, and suspicious of any unusual sight or sound.

Intercommunication: The calls I have described in "*Tropical Wild Life,*" p. 268. An important addition is the preliminary note. Before the beginning of the regular staccato trill, a single, high, sweet, long-drawn-out note is uttered, of about two seconds' duration, followed by an interval of three or four seconds, when the call proper is given. Rarely, when the bird becomes suddenly suspicious, the first note is given alone, but almost invariably it is the precursor of the call. Once I heard a low *chuck! chuck!* uttered by a male with a half-grown chick in tow. When the birds rise they are always silent, unlike pheasants, no matter how terrified they may be. On moonlit nights I have heard their usual call at intervals throughout the night, on cloudy days it is sometimes uttered at noon, while during no month of the year is the Variegated Tinamou wholly silent. It is, of course, always given from the ground, and probably

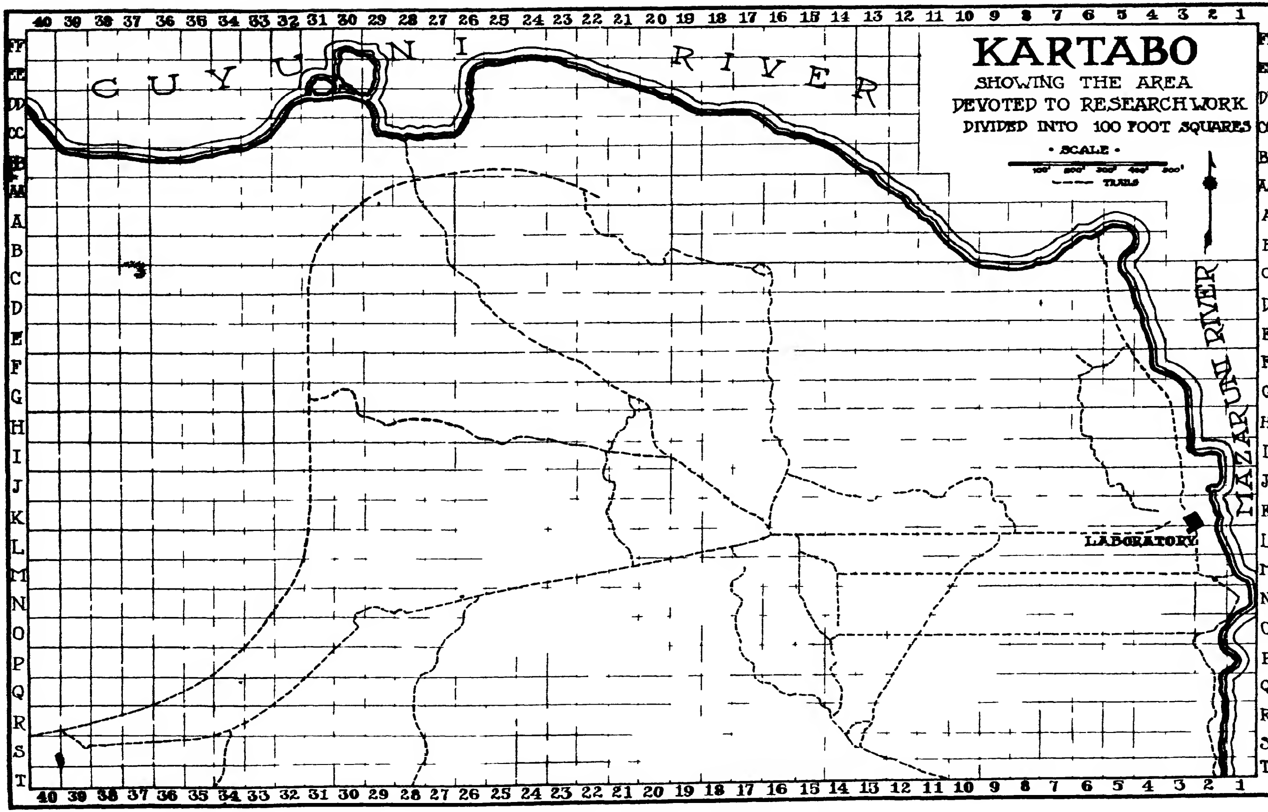

Plate B Area devoted to research at Kartabo
Drawing by John Tee-Va⁻

nine-tenths of the utterances occur between 5:00 and 7:00 P. M. and 5:30 and 6:30 A. M.

The first note of the call is usually on F natural, and is very sweet and penetrating, with considerable carrying power, being audible for long distances through the jungle. Several times I have heard these birds across the Cuyuni River, almost a mile away. It is a characteristic vocal utterance of solitary birds which inhabit deep woods, taking the place of motion, elaborate plumage, pattern and color of birds which have more of a chance to communicate by sight.

There is only slight variation in the calls of these birds; five individuals, whose notes I studied carefully, were unmistakably distinct; one had an unusually high tone, two others a nasal break, either in the first or second note, a fourth always uttered two, short, preliminary notes instead of a single long one, and the fifth called so regularly from exactly the same spot each evening and morning, with invariably seven notes in its refrain, that there was no doubt about its being the same bird week after week. I shall have more to say of the voice of this bird under courtship.

Natural Enemies: Three times I have found the feathers or other remains of this species in the jungle, once accompanied by the tracks of a margay cat or ocelot, and again by the pugs of some smaller carnivore; another record is of feathers of a tinamou in juvenile plumage, in the stomach of a spectacled owl.

Variegated Tinamou are naturally timid birds with a regular system of escape. When flushed in deep jungle they rise with a sudden rush of wings and scale off for twenty or thirty yards. They then come to earth and freeze for ten or fifteen minutes. If, as rarely happens, their landing place is accurately located, either by actually seeing the bird descend or the leaves moving, it is an easy matter to approach quite close and watch the bird for some time. It never moves while under surveillance, but stands like a bit of mottled jungle debris with its eye full upon the disturber of its peace. Nine times out of ten, the individual flushed evades all scrutiny or search. Even more than *Tinamus major* the plumage of this species merges with the jungle floor. There is no doubt that the birds unconsciously trust to their protective coloring, both in permitting a close approach at first, and in freezing after the escape dash. When one is crashing through dense undergrowth, the birds escape by creeping silently to one side, as I have now and then

observed when crouching at one side and watching the progress of one of my party near by.

Few individuals are free from ticks and bête rouge, two or three of the former being often scattered about on the face or between the upper scales of the legs, while the latter pests occasionally form large sores on the occiput and hind neck, with scarlet patches of the mites on the lores.

Once I saw a bird collide with a tree-trunk and fall stunned, although it ultimately recovered. But I believe that such accidents, due to imperfect steering ability, occur more frequently in the large tinamou than either in *Crypturus variegatus* or *soui*.

One bird brought in by an Indian hunter showed all the symptoms of old age,—worn beak, roughened tarsi, skull thicker than usual, and its flesh was unusually tough. I had, of course, no means of knowing how old it actually was.

Natural friends: These solitary birds seem to have no especial association with any other creatures of the jungle; more than once I have seen them stop feeding and look up in alarm at the warning rattle of an ant-bird which had discovered me, but this recognition of the quality of alarm in other birds' notes is common to most of the jungle fraternity.

Food: Of fifty stomachs, all contained vegetable matter, there being, in addition, insect remains. Small berries or fruits form almost the whole vegetable diet, many cherry-like with round pits, wild plums with oblong stones, hard acorn-like seeds, and occasionally fleshy fruits without pits or seeds. Of the four containing animal matter, number one had unidentifiable insect remains; number two, several small beetles and wire-worms; number three, a harvestman and a small beetle, and number four a roach.

All the food is procured on the ground, and the birds in company with accouries have favorite berry trees, under which, at the season of falling fruit, they may be found day after day.

Roosts: Variegated Tinamou are as solitary in their roosting as in other ways; they roost on the ground, or, as in two cases at least, on fallen logs a few inches up. Usually the choice of a place is deep within a tangle of lianas and vines, from which the bird could not possibly take immediate flight. The persistence and lengthened duration of these spots are shown by the considerable amount and limited locale of sign. I have kept close watch on a bird which eventually proved to be female, through a brief period

of intensive vocal courtship, and neither during it nor afterwards did the tinamou fail each night to roost by herself in her solitary tangle.

Breeding: My breeding records of this species, taken as a whole and including breeding adults, half-grown birds and eggs, show an unmistakable correlation with the seasons. They are as follows:

February	0	August	2
March	2	September	2
April	3	October	1
May	7	November	0
June	5	December	1
July	8	January	0

The half-grown young birds must be shifted into their rightful place in the month preceding their capture, and the egg of nest number 107 collected on July 4th with chick ready to hatch, must be accredited to June. There results a low average level for the duration of both dry seasons, and the short wet one, while a well-balanced peak of greatly increased breeding arises during the long rainy season, culminating near its beginning in May.

There are only three months during which I have no record of breeding and these would undoubtedly be filled up if I had more thorough knowledge of the field under observation. The calling of the females during every month would indicate that there is no absolute cessation of breeding, as there is in the case of *Tinamus*. This is undoubtedly directly correlated with the remarkable difference in nesting habits,—the simultaneous brooding of four to twelve eggs of *Tinamus*, and a single laying, repeated several times in succession, in *Crypturus*. The males of these tinamou take full charge of the single egg and the subsequent rearing of the chick. As I have mentioned elsewhere (p. 202) I have found a male, attended by a three-quarters grown chick, incubating a newly laid egg.

I should not like to make any assertion as to a single male taking charge of more than three eggs in succession, but from two-month period reawakenings of vocal calling in the vicinity of a single nesting area, and the number of young secured or reported from that place, I am quite sure that three eggs, one after the other, were incubated. It is interesting to note that the same female, judging from the break in a preliminary note of its call, in the time under consideration, underwent at least three other periods of song develop-

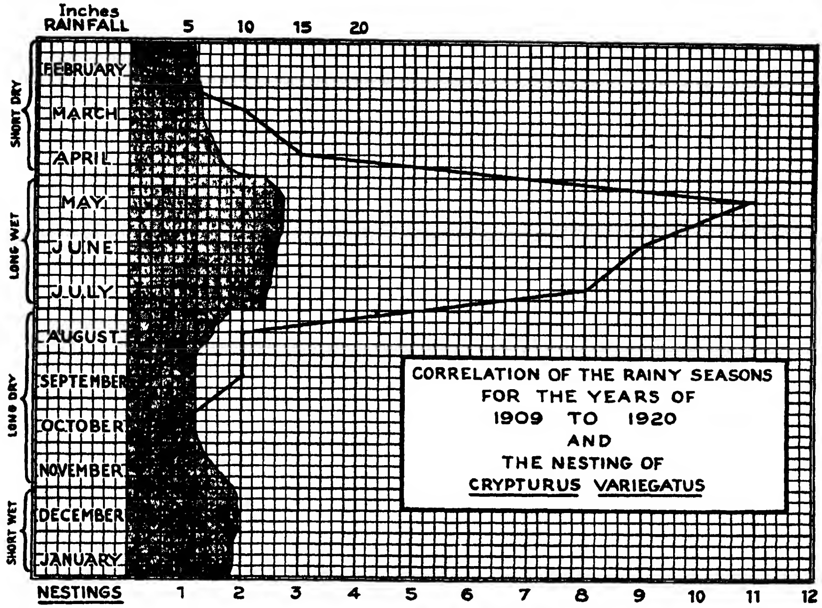

Fig 18 Correlation of the rainy seasons and the nesting of *Crypturus variegatus variegatus* (Gmelin)

ment in an area somewhat to the northward, and although I could never locate a nest or a brooding male there, it is probable that she was courting if not actually laying eggs for another male bird.

In addition to this instance, at the end of March I have secured a male Variegated Tinamou with one-third of the juvenile plumage still on the body, incubating an egg with a week-old embryo, and twice I have seen half-grown young birds in company with a single adult, presumably the male parent. My early experience with these birds indicated the remarkable proportion of sexes of eight males to one female. I now have a much larger series for comparison, and of forty birds secured within the area under observation, thirty-two are males and eight females, a very exact proportion of four to one. This is very probably the correct percentage.

Almost all of the usual calling is done by the females, while the more excited vocal courtship is wholly feminine. Only once have I ever heard two birds directly answering each other, and on this same occasion I had my first glimpse of tinamou courtship. The male (presumably) was perched on a fallen log near my hiding place,

while an approaching bird (later proven a female) came slowly, by short quick runs, from a bit of open jungle farther west. In the intervals between runs she gave utterance to a veritable ecstasy of calling—the usual dignified, deliberate scale being run and jumbled together, in an excited, high-pitched flood of tone. The male answered from time to time with the usual call, quite unexcitedly; with perhaps several months of brooding cares behind him, and more to come, we can hardly blame him for a restrained, philosophical exhibition of emotion. As the female approached, her runs became shorter and more irregular, her body plumage flattened, the head and neck were raised almost straight, and with rapid, mincing steps, her body vibrating with the effort of the continuous notes, she zigzagged toward the calm recipient of her attention. An abominable ant-bird discovered me at this moment and rattled and screamed his loudest. Both tinamous seemed to perceive me at once, the male slipped off his log, and the female rose in a sharp, twisting spiral and I shot her as she turned, to make certain of the presumed fact that it was indeed the females which did the courting.

A few weeks later I was hidden between two fallen logs waiting for a quadrille bird to return to its nest, when a tinamou walked into view, jigged, I might have said, for the bird was stiff-legged, and taking little mincing steps which shook her whole body and scuffed up the fallen leaves. It was exactly the tremulous heel-walk of an East Indian dancer when, with motionless body, he moves or almost floats across the floor with short, rigid, almost imperceptible jerks. The tinamou revolved slowly, and when her tail came around into view I could hardly believe it was the usual dull-hued species. The tail, or rather the ten, loose-vaned feathers which represent this almost obsolete organ, were upright, thereby pushing up all the elongated feathers of the lower back and rump. Closely applied behind were the under tail-coverts and even the feathers of the flanks, which now, flattened and with much of their surface exposed, proved to be really brilliant in color. With a shaft of sunlight striking them they fairly glowed; the tips of the tail feathers were buffy brown, then came a row of rich chestnut, then two rows of pale creamy buff with semi-circular narrow bands, then a beautiful patch of variegated feathers, white-tipped, with broad black and russet red bars, and finally the softer, black-banded flank feathers. The wings drooped, the tips nearly touching the ground, the beak pointed upward, and the rich cinnamon breast feathers were puffed out.

Three and a half turns did the courting bird make before she pirouetted behind the second log. What followed I did not see. I knew that the least movement on my part would send the bird headlong. My quadrille bird subsequently returned, I learned what I wished about her, and then, stiff from a prolonged squat, I arose painfully. Like a shot, two tinamou were up and bludgeoned off. Not a sound had they uttered, and after the faint scuffling of leaves which continued for a few moments after the bird disappeared, I had no knowledge that any tinamou remained in the vicinity.

The proportion of the sexes makes it almost certain that these birds are polyandrous, although, judging by the slender spatial and temporal bond between them, promiscuous would probably be the more appropriate term. The lack of spurs and the insistence of vocality indicates that courtship and rivalry are carried on in lady-like fashion.

It is difficult to imagine more remarkable contrasts than in the breeding habits of these two genera of tinamou. There are hardly any radical differences, either external or internal, between them, and no specialized characters on the part of the *Crypturus* males to help carry them through the long months of arduous incubation and feeding of the young. The single egg and young are the only factor of amelioration in this unusual achievement. And the life of ease of the female has no apparent compensation, unless it is the need to be so much more on the constant lookout for the dangers to which her continual calling must subject her.

Nesting site: Of six nests found within the quarter mile of jungle under observation, three were in dry, moderately flat jungle, two in somewhat swampy places, and one on a trail half-way up the slope of a low hill. They are apparently chosen without any thought of escape, for in three instances when the bird got up, it either struck against intervening lianas, or had some difficulty in getting away clear. There is little doubt but that the site is chosen by the male; the hen tinamou sticks too closely to her calling place, her feeding and roosting areas to do more than court the male and lay her single egg. Once I was sure of a second site being near a former one. I took an egg in a damp low bit of jungle, and a week later flushed the bird from a new, well-formed, but as yet eggless hollow eight feet distant from the first. He did not however, return after this second alarm.

Nest: No attempt is made to form a nest. Attracted by some

unknown choice, a spot is selected, and is made into a home literally by squatting. If leaves and twigs or other jungle litter are beneath the breast of the bird, they are pressed down and form the sole lining; if not, the mold alone receives the pressure and is gradually rounded into a shallow form.

Egg: A single egg is laid at one time and incubated. Six eggs have been collected from as many nests generally distributed in the Kartabo research area, and these show weights, dimensions and stages of incubation as follows:

30 grams	47 × 34.5 mm.	Four day embryo
29 "	45.5 × 34.8 "	Fresh
34 "	51.2 × 36.1 "	Two day embryo
31.3 "	49.5 × 36 "	Full-grown embryo
29.5 "	45.5 × 35 "	Seven day embryo
34.2 "	50.7 × 36.7 "	Fresh

There is perfect correlation between weight and dimension, but, as is evident from the following table, there is no relation between weight and incubation:

Weights	*Average of length and width*	*Incubation*
29 grams	40.1 mm.	Fresh
29.5 "	40.2 "	Seven day embryo
30 "	40.7 "	Four day embryo
31.3 "	42.7 "	Full-grown embryo
34 "	43.6 "	Two day embryo
34.2 "	43.7 "	Fresh
1	1	1
2	2	5
3	3	4
4	4	6
5	5	3
6	6	2

The extreme weights are 29 and 34.2; average 31.3 grams.

The extreme dimensions occur in the two fresh eggs, 47 by 34.5 and 50.7 by 36.7, the average being 48.2 by 35.5, or compounded 41.8 mm.

There is little variation in the color, the surface showing an exquisitely delicate tint which is but poorly expressed in our English

Fig. 19. Nest and egg of the Variegated Tinamou *Crypturus variegatus variegatus* (Gmelin).

term of light purple-vinaceous. There are sometimes zones of lighter tint about the larger or smaller end, due to some physiological cause in the lower portion of the oviduct. I consider the color of *Crypturus* eggs as distinctly protective, much more so than those of *Tinamus* whose turquoise sheen is readily seen against the jungle debris. As such it is at least one ameliorative factor in the risk of the small number, and the danger of the continuously breeding male bird. The birds always sit close, however, and only when almost stepped on, do they boom up and away. Many an egg would go undetected if instead the sitting tinamou would creep stealthily off at the first hint of danger. The gloss of the egg is not quite as high as in *Tinamus*, but it is still far ahead of any other bird's egg with which I am familiar,—one of the most beautiful shells in the world.

Out of the observation area I have known three eggs of the Variegated Tinamou to disappear suddenly long before incubation was completed, but only in one case do I know the cause, when a herd of peccaries trod heavily over the nest and all the neighborhood, a few fragments of yolk-stained shell showing how a single crunch had provided some wild pig with a delicious mouthful.

I have taken a fully-formed, but white and glossless egg from a bird more than half-way down the oviduct, so the pigment and gloss must be added very far down, just before the egg is laid.

Young: Incubation lasts about twenty-one days, and I have two notes, one of my own and the other by an assistant, of nests being deserted twelve hours and twenty-four hours after hatching. The parent therefore has at least the precocity of his offspring to lighten his labors. We have secured two young birds of about two and five weeks respectively, feeding by themselves at a distance from the parent, so the precocity extends to the independent juvenile life, thus allowing the male to take up, unhampered, a new round of domestic duties.

Relation to man: The Indians know the Variegated Tinamou as Orri-orri, and shoot it for food. As to hunting, the account to come under *Tinamus* holds, word for word, for this species as well.

External Characters

Weight: Adult Variegated Tinamous weigh from 345 to 393.5 grams; or $^3/_4$ to $^6/_7$ of a pound. Males vary from 345 to 374 grams; females from 356 to 393.5 with an average of 352 and 372 respectively, giving the dominant sex an excess of almost ten per cent.

Dimensions	*Males*	*Aver.*	*Females*	*Aver.*	
Total length	291. –325.	310.7	310. –331.	323.	4%
Culmen	28. – 31.	29.8	29.5– 32.	30.7	3%
Width of nostrils	5.5– 6.2	5.9	5.5– 7.	6.4	8%
Eye diameter	8.5– 9.3	8.9	8.4– 9.4	8.9	—
Wing	155. –170.2	161.	159. –174.2	165.5	3%
Tail	45. – 50.	47.6	39. – 50.3	47.7	—
Tarsus	42. – 47.	43.8	44. – 48.	45.6	4%
Middle toe only	24. – 27.5	25.3	25.2– 26.8	25.5	—
Extent	515. –540.	529.5	536. –551.	546.	3%

For a sex dominant in courtship, female tinamou exhibit remarkably little specialization of secondary sexual characters; with plumage hardly to be differentiated, the birds show greatest differentiation in weight (10 per cent). In six body characters the females show an average excess of a fraction over four per cent, being equal in eye diameter, tail and length of middle toe.

Fleshy colors: There is little or no variation in the sexes in these colors. Beak, the upper mandible and the cutting edge of the lower are black; terminal half of lower, dusky; remainder of lower, cream buff. Eyelids, citrine drab. Iris, dark chestnut. Legs and feet citrine drab; claws on middle toes somewhat lighter.

Face and eyelids: In the full-sized young bird there are more feathers around the eye than in the fully adult. At first there are two complete rows, while in older birds these are reduced to a short row of about nine to ten minute feathers above and a short double row below.

Oil gland: Low, dark, spreading, truncate, anteriorly superficially divided by a slight crease; with two tufts of down on the summit, or occasionally four in the fully adult, the latter number arranged in the form of a square.

Claws: The thumb is without a claw in the adult; the index finger has a well-developed one, sometimes unworn and curved, or again worn down to a rounded nodule.

Wing graph: The wing is short and much rounded, with a deep inferior concavity; the outline of the primaries in the spread wing forms more than half a circle, while the corresponding outline of the secondaries is a very shallow segment of a circle. There are ten primaries, the outermost or 10th being considerably less than one-half the length of the 9th. A rather unusual condition exists at the

juncture of the two main series of flights; the 11th flight feather, in size, curvature, shape, pattern and follicle isolation is a true secondary, yet in actual position it arises quite distinctly from the head of the metacarpal and not from the ulna. I have chosen, however, to consider it as the 1st secondary which has been carried over the basal limits of this series. There are twelve secondaries, followed by three more feathers in the same linear series, but which are so soft and of such small size that they can take no part in actual flight.

Immature plumage: A two-thirds adult bird, weighing 303 grams, has the top of the head like the adult, except that it is dead black without a greyish cast; short feathers behind the eye and a few on the nape have pale-buff, subterminal, lateral spots; chestnut of the neck and upper mantle are much duller than in the adult. The dorsal contour and upper wing coverts are about one quarter juvenile, and three-quarters post-juvenile. On the dorsal body the juvenile feathers are pale, dull Saccardo's umber. In the last juvenile feather to come in there is a small, central subterminal black spot, below which is a touch of cinnamon buff; the first adumbration of the adult colors. This color is interesting as being an exact shade of darker, more generalized color than cinnamon buff (Ridgway's Color Standards, Plate XXIX, 15'' d and 17''k). In the post-juvenile plumage the spot has expanded into a broad, wedge-shaped, subterminal band, wholly bounded by cinnamon buff, the tips of the barbs black. The latest appearing feathers, still partly ensheathed, show the three adult cinnamon buff bands dull but fairly well developed. In the post-juvenile moult the lengthened lower back and rump feathers are developed. On the juvenile tail-coverts, which in this plumage exceed the tail in length, the umber is here so extensive that it encloses a very broad band of the basal block.

The corresponding plumage on a fully adult bird shows the wedge-shape lost, the markings having become straight cross bands, and the feathers themselves much wider and more truncate. There are two solid bands of golden cinnamon buff and distinct traces of a third, all separated by wider bands of black, the distal one being terminal.

The ventral plumage in the immature bird is much more juvenile in pattern than the upper. The breast shows only a sprinkling of adult, self-colored cinnamon feathers, the present plumage exhibiting the juvenile, subterminal, elongated black patch, with the large, rounded, central, terminal white spot. On the lower breast the black

disappears, the white widens to a band, and the basal cinnamon fades until on the abdomen the feathers become pure white. On the sides there is a mingling of pectoral and dorsal patterns, resulting in many combinations of spots and bands, black, cinnamon, buff and white.

On the greatly elongated femoral wing, which is wholly distinct from the lengthened dorsal plumage, the basal color is dull cinnamon brown, with a wide, terminal band of white, bordered by an irregular, dark clouding. This tract extends from the front of the femur quite to the lateral rectrices, and the feathers are 40 mm. in length; they curve around between the thighs and the tail, meeting in midline, tips on, and covering all but the longest under tail-coverts.

The under tail-coverts, are, as in the adult, the most brilliant of the whole plumage, but strangely enough, they are even more conspicuous than in the adult, and when all in position, form very closely defined zones of color. The smallest, basal, anterior feathers are rich chestnut with a wide border all around of creamy buff and an arrow-shaped center of deep black; the following several rows of larger feathers are clear vinaceous buff; the last, largest row is particolored, considerably longer than the juvenile rectrices, with worn tips, showing how they have been functioning as tail feathers. Those on each side have the outer webs mostly chestnut, farther in, the black-center-buff-edged type prevails, while the central pair are almost wholly buff.

The juvenile rectrices are ten in number, the longest 41 mm.; the visible areas dull chestnut, mottled with black. Moult begins with the outer pair, the post-juveniles being almost clear black, with two, wavy but complete transverse bands of golden cinnamon buff, and more or less distinct traces of a third.

This two-thirds grown bird shows four nodes of moult in the wings. There are ten primaries, eight secondaries, and six tertiaries. The outermost, 10th, short primary is just losing the last basal sheaths of its long delayed growth; the innermost, or 1st primary, together with the 2nd and 3rd are new and full-grown, the latter still with blood at the base; 4th four-fifths grown, 5th a one-inch blood sheath, 6th to 10th old; 1st to 5th secondaries old, 6th just shed, 7th small blood sheath, 8th four-fifths grown; 1st tertiary half-inch sheath, 2nd to 6th old. Thus we see four moults, in the 10th primary, 1st primary, 8th secondary and 1st tertiary, the two distal being centrifugal, the two distal centripetal.

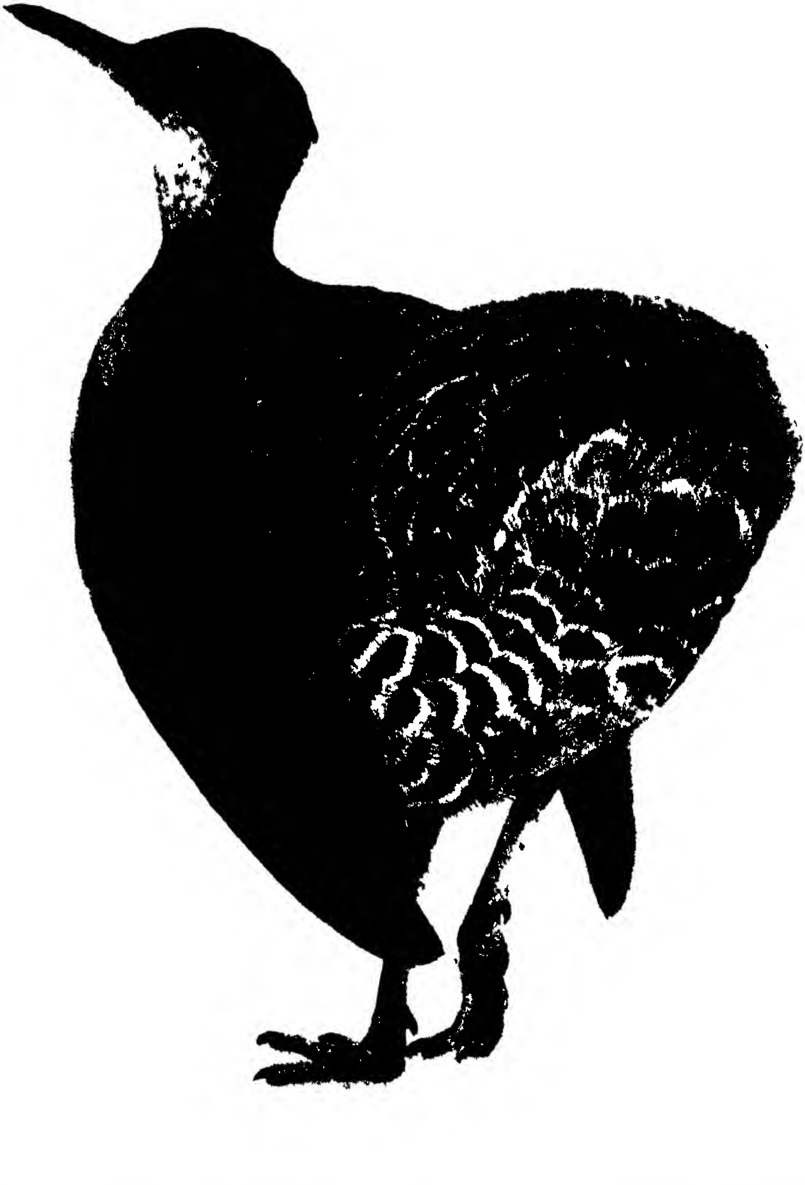

Fig. 20. *Crypturus variegatus variegatus* (Gmelin). Female in the position of courtship. From a color drawing by Helen Damrosch Tee-Van

Juvenile primaries have a faint, outer, terminal edge of russet and in the next moult this is reduced to a single subterminal notch of pale buff; the second post-juvenile moult sees the disappearance of this spot, and the primaries immaculately adult. In the juvenile plumage, the only difference in the feathers from the 6th tertiary to the 3rd secondary, is a gradual reduction of the russet on the tips and outer webs, correlated with the amount of exposed surface in the closed wing and a thin line of white along the outer web of the outer secondaries. In the innermost tertiary this russet covers half the entire feather, while in the 3rd secondary it is reduced to a broad, mottled, outer margin. The new secondary moult beginning with the 8th, marks a radical change to the adult, where the feather is wholly blackish brown except for clear-cut mottling along the outer third and a subterminal band of pale golden buff, reaching almost to the rhachis.

Comparison of the relative dimensions of birds in juvenile plumage with those fully adult, reveals some interesting facts. Such a comparison is as follows, with the ratio of percentage of the young birds:

	Juvenile	*Adult*	
Length	244.	310.7	78 per cent.
Culmen	24.5	29.8	82 " "
Eye diameter	8.	8.9	90 " "
Wing	142.	161.	88 " "
Tail	40.5	47.6	83 " "
Tarsus	41.5	43.8	94 " "
Middle toe	24.5	25.3	97 " "
Extent	465.	529.5	87 " "
Weight	241.	359.5	67 " "

The significance of these figures is apparent when we rearrange them in the numerical order of percentage values. First, and nearest to the adult is the toe length, 97 per cent.; the organs which of all others are of most importance in avoiding danger and seeking food. Closely following and directly connected with the toes is the tarsus, 94 per cent., while the eye, 90 per cent., deserves its high place as the second most important vital organ in the life of these birds. The wing, 88 per cent., comes next and it and its necessary corollary, the extent, 87 per cent., are the chief secondary line of defense when escape by foot is impossible. The tail, 83 per cent.,

is of less vital need, and the beak, 82 per cent., functions as well whether it is a few millimetres shorter or longer. The total length 78 per cent. is of no dominant importance in viability, nor is the weight, 67 per cent. Taken all in all, this table of statistics becomes really vitally significant when we interpret it in terms of the actual life of the organism.

Scalation: *Front;* Twelve to fourteen scales, the uppermost split in two, above this a group of faintly marked scales. *Inner;* Acrotarsium 30, 50, 50, 50, 30, planta tarsi about 20, between these are several rows of irregular diamond and hexagonal shaped scales. *Back;* Many small, irregular, hexagonal pavement scales on upper half of heel, from middle of heel to base of tarsus, ten to twelve scales, lowermost divided into two. *Outer;* Similar to inner, but often with less of acrotarsium, and more of planta tarsi visible.

Adult plumage: Crown of head and nape, black, paling to slate grey on sides of head, crown, forehead and lores. Ear coverts blackish brown; chin and throat, white; neck, dorsal and sides, chestnut; neck below, tawny, shading into cinnamon on mid-breast, and cinnamon buff on lower breast, many of the feathers faintly ringed with both hues. Mantle, back, wing-coverts and tail and sides of body, black, barred on mantle and back with a sub-terminal and terminal bar of golden cinnamon buff, the terminal bar changing to pinkish buff on the wing-coverts, longer tail-coverts and sides of body, and into greyish white on the flanks. Under tail-coverts variable, russet toward the base, followed by more or less black and tipped with pinkish buff.

Alula feathers along front edge of wing, primary coverts, primaries and secondaries, blackish brown; secondaries barely edged with pinkish buff on the proximal outer edge of outer web. Lower breast merges posteriorly into pinkish buff and on middle abdomen to greyish white. Tail feathers, neutral grey, with faint irregular terminal mottlings of russet and black.

Powder downs: In this *Crypturus* these tracts are dorsal and paired, consisting of two elongated patches down each side of the back, beginning 15 mm. back of the tips of the scapulars and ending at the antero-lateral base of the oil gland; each patch is a dense growth of long, greyish-white down, 15 mm. wide in front, narrowing to eight posteriorly, and 70 mm. in total length. These feathers penetrate the skin more deeply than the bases of the contour plumage, and lie almost flat, arranged in seventeen lines, a double row of feathers in each line.

Aftershaft: This structure is well developed on the contour plumage, the length averaging more than half the total length of the feather.

Parasites: Like all animals of the jungle floor, these birds suffer considerably from the attacks of bête rouge, those ever-present, larval *Thrombidium*, which attach themselves in great numbers to the more inaccessible portions of the body, such as the lores, ear openings and especially the rear crown and nape. The feathers here are sometimes quite worn away, or their follicles destroyed by the dermal irritation set up by the masses of mites. A tick is occasionally found clinging to the aural aperture, but these creatures offer little inconvenience.

Mallophaga are moderately abundant, but always present. On one individual I have found an elongated species, with spade-shaped head, and a series of lateral, brown sclerites which do not meet across the abdomen; together with another species, a broad-bodied, reddish-bordered insect, with large head, with wide and backwardly-directed horns. The latter are about ten times as abundant as the former.

Nematodes of two small species are present in almost all tinamou, while tape-worms are much rarer. I have taken one of the latter, one hundred millimetres long, with one hundred and fifty segments, from an immature female bird.

Internal Characters.

Pecten: 2 mm. high; 6.5 long at base, 3 mm. at summit; twenty-three folds. Eye-ball 16.5 mm. in diameter.

Palate: Palatine fissure very far back; no denticulations on palate; the fissure has narrow, parallel sides for the anterior three-fourths of its length, expanding posteriorly.

Tongue and glottis: The tongue is very simple, triangular, with the longest arm in front, blunt, fleshy, posterior cornua with a gentle curve along the posterior side; tongue length 8, width 7 mm.; mandible length 53, width 17 mm. Glottis immediately behind the tongue, a well-developed epiglottid fold intervening; the opening long and parallel-sided, with rounded ends, no denticulation.

In a half-grown bird the tongue has much terminal pigment; the dimensions are length 7.5 mm. by 5 mm. broad. Faint lines along the posterior edge of the tongue and around the glottis may indicate vestiges of buccal teeth.

Syrinx: Extrinsic muscles arise at the 18th tracheal ring, where they close at once across the entire trachea, forming a nearly opaque sheath of muscle which extends quite to the larynx, slightly thinning as it goes; the fibres of one side of the overlapping extrinsics are usually dominant and overlaid upon the other; usually the left-hand ascending fibres overlie those of the right, before merging in the general longitudinal sheath. The free part of the extrinsic is about 25 mm. in length, very broad, 3 mm. in width, and curves around the lateral portion of the trachea as a curved sheath; farther on it narrows to 2.5 mm. in width and continues as a very thin ribbon-like muscle to its attachment on the sternum. Posteriorly almost all the fibres of the extrinsics extend on up the sides of the trachea, the extension across the centre being much thinner than in front.

The intrinsics are absent; posteriorly a very thin transparent, silvery, tendonous sheath extends down the centre of the trachea, covering more than half its width from the juncture of extrinsics to the syringeal collar; it here divides and is continued down the bronchi to the lung tissue, hence it may be considered as a second pair of extrinsic muscles.

Underlying this tendonous tissue is a very thin layer of muscular fibres, which increase slightly in density on the syrinx proper, but are wholly insufficient to manipulate the internal vocal pads. This posterior layer does not extend down the bronchi, but exhibits an abrupt attachment at the 1st tracheal ring, and passes in a solid sheet on to the aesophagus.

The tracheal length from the larynx to the 1st tracheal ring is 105 mm. Just back of the glottis the trachea is enlarged, but after a short distance the calibre rapidly becomes smaller, remaining so as far as the insertion of the extrinsic muscles. Here it again enlarges into an elongated cartilage box extending to the syrinx proper. The diameter behind the glottis 5 mm., midway down the neck 3.3 mm., largest diameter of the cartilage box 4.4 mm. The trachea is round throughout except for the box which is slightly compressed.

There are 125 to 130 rings from the larynx to the 1st tracheal ring. These are moderately wide and even-edged, with very rarely any traces of median thinning. Usually they are of the same calibre throughout, averaging half a millimetre in breadth, and they lie close together, separated when contracted, by an eighth to a third

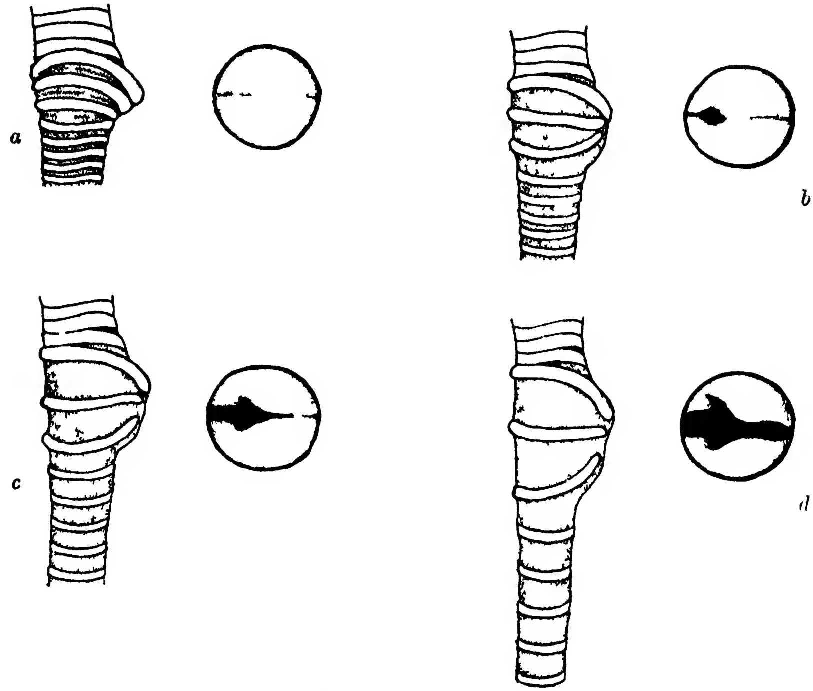

Fig. 21. Syrinx and cross-section of the bronchi of *Crypturus variegatus variegatus* (Gmelin). When the aperture is widest the lowest note is produced. The gradual variation of the aperture is shown in *a*, *b*, *c*, *d*.

of their width of membrane, and when stretched, being only half their width apart.

The first change in character is at the level of insertion of the extrinsic muscles. From here the diameter increases and then decreases again to the syrinx, so that the trachea here assumes a slightly swollen, bulbous appearance, with an increase at the greatest diameter of almost 50 per cent. This diameter is reduced to 4 mm. at the upper neck of the syringeal collar. Another change is the still greater reduction of inter-annular membrane, so that this is practically, as I have said, a cartilaginous box, with extremely little mobility. An interesting thing is the frequent presence of numerous angular granules of dark pigment scattered along the fine membrane joints of this box, often extending on to the syrinx proper and even over the extrinsic muscles.

This specialized area begins about the 20th tracheal ring. At the level of its greatest diameter, the 7th ring shows a very slight downward bend anteriorly, and this increases rapidly in the succeeding rings, the sides maintaining their narrow calibre. In the 4th and 3rd rings, there are wide, triangular, downward projections in front, while the 2nd and 1st rings become again equal in breadth throughout. This last ring has a very steep downward slope and forms the arch of the bronchi.

The anterior ends of the 1st bronchial semi-rings articulate at the arch with the apex of the 1st tracheal ring, and in fact are closely connected with that ring throughout; in the relaxed, unstretched trachea the 2nd pair of semi-rings also concentrate at the arch and extend slightly obliquely upward from that point; the anterior ends of the 3rd semi-ring in their turn, lie as closely as possible to the arch, and extend out nearly horizontally. In the fully stretched syrinx the 2nd semi-rings are the horizontal ones, resulting in a considerable extent of membrane between these and the 1st semi-rings. The 3rd pair of semi-rings, in this extended condition, shows a very strong, downward curve at the sides, the anterior ends reaching up with their elongated tips toward the arc. There are thus two very wide expanses of membrane between the first three pairs of semi-rings.

The first four pairs of semi-rings are seen in their most normal relationship only in the fresh, relaxed syrinx. They are rounded and rod-like, in pronounced contrast with the flattened rings above, and semi-rings below, and are much longer than the neighboring rings, projecting considerably in front, often with a diameter of a third greater than the antero-posterior diameter of the tracheal box above. The anterior bellying is due to the projecting and overlapping ends of the first three pairs of semi-rings. There are sixteen undifferentiated semi-rings ending in the lung tissue, making twenty altogether.

Posteriorly, the structure of the syrinx is quite as simple as in front. The 1st tracheal ring and often the 2nd is broken. These, together with the ends of the 1st and 2nd semi-rings, are, as in front, all rather concentrated toward the bronchial arch, lying in two parallel rows in a sort of elongated, median groove which, were it a single sheet of membrane, might be called a bronchidesmus.

The exact method of voice production in this bird, is, I believe, unknown, and as long as only alcoholic specimens were available

there was slight chance of its being demonstrated. Acting on my accidental discovery, in the case of *Ibycter americanus*, of the possibility of reproduction of the whole vocal gamut by manipulation of a decapitated specimen, I attempted a similar feat with *Crypturus*. With four individuals I had no results whatever, and my efforts with the fifth were half-hearted, but met with instant success. Holding the bird on its back, and seizing the neck firmly, I stretched it to full extent and struck a sharp blow on the side of the breast muscles. At the second attempt I obtained a clear, high note, which if prolonged, would correspond exactly to the first long-drawn-out note of the bird's call. I repeated this several times, and then by slightly relaxing the tension I extracted a higher note, and so on until nothing but a shrill hiss of air came through the almost closed syrinx. This mechanical stretching and contraction of the respiratory organs followed the natural movement of the bird's neck when it was calling, the head and neck being drawn slightly downward as its notes rise successively higher in the scale.

The physiological method of voice production is seen clearly if the trachea be amputated just above the syrinx, and the latter held upright under a low-power lens. With a forceps grip at the edge of the trachea and another on the lowermost semi-ring of one of the bronchi, we may approach closely to a realization of the modus operandi of vocality. To reverse the sequence of tones, if I allow the structure to shrink together by its own weight, and then look directly downward, the bronchus is seen to be completely closed. A barely distinguishable seam extends straight across the center of the lumen. At a slight pull on the trachea, a tiny rounded opening appears in the seam, considerably nearer the posterior aspect of the syrinx; another pull and this widens, extending as a broad, open band quite to the posterior rim, and tapering anteriorly to a point more than half-way across the bronchus. The area of the original rounded opening opens out laterally into two flange-like windows. Again a tug, which takes up almost all the slack, and the vocal slit extends across the entire diameter, the lateral projections having become wider, almost wing-like. The plate (Fig. 21, *a*, *b*, *c*, and *d*) demonstrates these four phases far better than any mere description. No matter how little or much stretching tension is applied, only the syrinx and bronchi are affected; the tracheal box being quite immobile from the 1st tracheal ring upward.

There are two large cartilaginous cushions or partitions on each

side of each bronchus, the separation of which medianly is brought about by the extension of the syrinx and bronchial tubes. The most careful examination of this internal tissue reveals no trace of muscular fibre, only very soft elastic cartilage, of exactly the right mobility and elasticity to separate and close at the will of the external muscles.

A longitudinal section of the syrinx and upper bronchus shows that the lateral wing-like extensions in the partially open bronchus are due to a contracted area in the cartilage at that point. Even in the closed condition this division is very conspicuous on the inferior profile, and in this we have a clue as to the actual production of these lateral openings. The cartilages are thick and rounded, while on the outer and inner walls this tissue extends, as a gradually thinning sheet, down the bronchus. When the bronchus is stretched, these tracts are drawn down, the rounded, constricted syringeal cartilages are somewhat rotated inward, toward one another, and the ventral constriction, also rotating inward, produces a mutual gap, rounded at first, and extending more and more laterally as the stretching tension and rotation are increased. There is no marked difference either in the analogy or homology of this phenomenon in juvenile and adult tinamous.

Syringeal Variation: I have described an average, normal syrinx, but examination of several dozen of this species reveals a number of individual variations, showing that there is a slight latitude in the architecture of the organ which produces very similar sounds.[2]

A progressive tendency due to age is an increased ossification of the lower tracheal rings, both in front and behind. In the juvenile syrinx of two individuals the 1st tracheal ring was not quite connected anteriorly, making it actually in these isolated cases, the 1st semi-ring; posteriorly in three young birds the lowermost three tracheal rings were all broken, while in one juvenile bird, four trachael rings were broken behind. As a rule in the adult the 1st tracheal ring is complete anteriorly and posteriorly the 1st and 2nd tracheal rings are broken. In old birds the 1st tracheal and the 1st semi-rings may be united by an osseous bridge across the anterior centre, rarely with a foramen in the middle, or, as in two extremely old females, the 1st bronchial, and the 1st and 2nd tracheal rings may be solidly fused in front, while posteriorly, very rarely, even the 1st tracheal ring may be solid.

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[2] See page 216 for variation in the voice of *Crypturus*.

Visceral anatomy: described from adult female, W. B. Coll. Vert. No. 591. The flesh is pale greyish-green in color.

The crop is large, about 15 mm. in diameter when partly filled, and lying in the inter-furcular hollow; liver large, capping the gizzard, the lobes somewhat unequal, the left the larger, 24 mm. long, the right being 29; the left sends down internally a 10 mm. lobe, lying on the gizzard, while the projection of the right lobe is narrower but slightly larger, and applied to the side of the gizzard. The proventriculus is 25 mm. long and 11 in diameter. The gizzard is large and its anterior edge is turned slightly toward the right, dimensions 36 long by 34 deep by 22 wide. The lining of the proventriculus is loose and about to be shed, thin, white, and filled with large, vacuole-like glandular pits; the gizzard lining is also ready for sloughing; it is dark brown, rough, with numerous irregular cracks and pits, much like the bark of a chestnut tree.

The small intestine has an average diameter of 5 mm. and the remarkable length of 1030 mm. ($40^1/_2$ in.); the large intestine is 10 mm. in diameter and 85 mm. ($3^1/_3$ in.) in length; the caeca are extremely large, elongated lobes, constricted at the neck and increasing in girth to the extremity; they are 5 to 15 mm. in diameter and 75 in length. The large intestine and caeca are darker in color than the small intestine.

Heart moderate in size, 17 mm. long by 14 wide.

Chick of *Crypturus variegatus*.

On June 9th, 1922 a single egg of the Variegated Tinamou (set number $234^0/_1$) was taken from a nest on the ground in the jungle in S_{17}. It was light purple-vinaceous with the usual highly polished surface, weighing 33 grams, and with the dimensions 47.3 by 35.6 mm. As well as I could determine through the dense pigmentation, the embryo was five or six days old. The egg was placed in the incubator in a temperature of 100 to 103 degrees and dampened and turned regularly.

Sixteen days later, on June 25th, the egg was pipped at ten o'clock in the morning. Two hours later the chick was out, partially dried and creeping about all over the shelf. It was a male, as was ascertained later, weighed 16 grams, and the two pieces of egg-shell weighed 2 grams. A very considerable residue remained in the small end of the shell and weighed 2 grams more. Compared with *Tinamus major* these weights are as follows:

	Tinamus	*Crypturus*	
Egg	53	33	62 per cent.
Chick	38	16	42 " "
Shell	5	2	40 " "
Adult	1133	362	32 " "

The shell was broken by direct outward pressure of the egg-tooth at twelve distinct places around a very straight line, exactly 10 mm. or one-fifth of the total distance from the large end.

The dimensions of the one day chick compared with the average of twenty-eight adult males are as follows:

	One day Chick	*Adult Male*	*Chick's Dimensions*
Total length	103	310.7	33 per cent.
Culmen	12.5	29.8	42 " "
Width at nostrils	3.4	5.9	57 " "
Eye diameter	5.8	8.9	65 " "
Wing	23.5	161	14.5 " "
Tail	20	47.6	42 " "
Tarsus	19.5	43.8	44 " "
Middle toe only	16	25.3	63 " "
Extent	90	529.5	17 " "

The most significant fact in this table is that the three dimensions in which the chick reached more than 50 per cent. (width of bill 57 per cent., eye diameter 65 per cent. and middle toe 63 per cent.) are of organs of apprehension, of sight and of speed, the three most necessary qualities in the life of the newly hatched chick.

The beak is pinkish grey, shading to fuscous on nostril tube, gape and tip; the bare portion of the lower eyelid is light purplish grey, the very narrow fleshy eye rim dull olive brown; iris dark hazel; legs and feet yellowish buff touched with pink, heels and sole pads dark purplish grey, tips of toes and upper half of claws grey, claws cream color.

There are numerous, small, golden, tawny down feathers around the eye, a single row in front, increasing to three or four at the back; the upper lid is densely feathered with normal head down, upper half of lower lid bare, lower half fairly densely covered with bristly tipped down.

Oil gland conspicuous, flat-topped, deeply bisected, surmounted

with three tufts of down, dark and slender at base, fluffy and pale buffy at the tips. There are small but perfectly distinct claws on the pollux, and large, well-developed, subterminal blunt ones on the index fingers.

The egg-tooth is low, not very sharp, and at the extreme tip of the upper mandible. It spreads out into a large, flat base, extending one-sixth of the total length of the culmen. It is an ideal pressing tool, the pressure force being distributed over a large surface of the soft beak.

The position of the chick in the egg is also very obviously an adaptation to facilitate shell breaking. The neck and head are folded close to the breast and abdomen, while the right leg is raised far forward and sideways until the beak rests directly on the under side of the flexed tarsus. Pressure is thus brought to bear on the shell not only by movements of the head but the slightest effort at extention of the leg and foot automatically forces the beak in general and the egg-tooth in particular against the inner wall of the egg-shell.

A very deep lateral groove begins near the tip of the maxilla and extends back to the nasal fossa. The nostrils are large, with a light-colored operculum covering half of the deep opening, and extending back into a conspicuous, swollen tube, directed slightly upward.

A very deep groove on the mandible pinches off the swollen median portion extending along the gonys quite to the rami, corresponding in size and position to the area shut off by the groove on the maxilla.

In the wing of the newly hatched chick, five primaries are already so far developed that the prenatal down is supported on their tips well above the skin. On the morning of the third day when the chick died, these feathers showed very considerable additional growth. There are in all nine primaries visible. The outermost or 10th is well developed but short, the next five are very long, and the inner three are short. The average length of the five long ones is 6.3 mm., of the four short primaries 3.6. The 1st primary is not distinguishable except as down, and the same is true of all the secondaries.

A typical mid-dorsal down is 18 mm. long, and consists of about twenty barbs, which are simple and spring mostly from the basal sheath, although a main shaft is distinguishable, with several shorter side barbs. The barbules are long and very fine and silky, and of

equal length throughout, dying out abruptly and leaving a long bare tip. They are greyish white at base, black throughout the middle length, and suddenly and strongly tawny red on the last distal barbules and the long terminal shaft.

The tail down is surprisingly long, both in front of the oil gland on the lower rump, and behind it where the future rectrices will appear. In fact a semi-circle of sixteen or twenty large down curved along the tail area are unusually strong, and may be twenty-three mm. long, the tips curved conspicuously around and down, giving the chick an appearance unlike any other young bird. This tail down is decidedly dendritic, with only six or eight barbs arising basally, the others branching from a thick main shaft, which only near the summit trivaricates into barbs equal in size to the others. The barbules differ from those of the dorsal down in being shorter, farther apart, standing out from the barbs at wider angles, and also in giving the appearance of a radial rather than a bilateral arrangement. The whole down is solid russet in color.

The Scalation resembles that of the adult as regards the larger scales of the acrotarsium and plantar tarsi, but the outer and inner aspects are much simpler, with far fewer scales than in the old tinamou. Front: fourteen scales, the top three broken into two or three; inner: acrotarsium 40, 40, 50, 50, 60, and 20 per cent., plantar tarsi 50, 50, 40, 40, 30, and 30 per cent., the narrow slit between forming a simple out-bent fold of skin; back: twelve plantar tarsi tarsi scales, beginning on heel, lowermost split into three, nine hexagonal, irregular scales down inner side, which might be considered as a scale row of the inner aspect; outer: 10, 40, 50, 50, 50, 50, and 60 per cent., plantar tarsi 20, 20, 20, 20, 10 per cent., the remaining surface covered with two, or for a short distance three, rows of small hexagonal scales.

Plumage: The chick of *Crypturus variegatus* is much more brilliantly colored than that of *Tinamus major* and the body pattern is simpler. Taken as a whole, the colors are curiously reversed, the dark chestnut back color of *Crypturus* being ventral and lateral in *Tinamus*, and the golden tawny of *Crypturus'* breast being found on the back of the larger chick.

The forehead of *Crypturus* back almost to midcrown, a broad band over the eye and back to the nape, together with the facial down, tawny olive, becoming lighter and more silvery well back of the eye. The basal half of the loral down is black, giving this area

a dark appearance. At the posterior corner of the eye a narrow band of bay extends backward over the ear-coverts, widening on the side hind neck and merging with the dorsal color. This is bordered narrowly with black. The crown and upper nape are bay, except for a median spot and a narrow irregular line of tawny olive which begins on the mid-crown, well behind the forehead color, and extends medianly back to the hind neck. The entire upper and lateral body down is uniform bay or dark chestnut, reaching well down in front of the wings, including the lesser wing-covert down and the more dorsal elongated tail down. It is separated laterally from the ventral colors by a well-marked line of black. The chin and throat are whitish, becoming ochraceous tawny on the breast, lower sides, flanks and thighs. The side breast is deeper tawny and the abdomen paler buff. The greater mass of tail down is russet. The greater wing-covert down is ochraceous tawny, the sprouting quills blue-black.

Biology of *Crypturus* Chick: The chick pipped the shell at ten in the morning and, as I have already related, was out and partly dried at noon. The down dried well except on the back and head, until I put in a circular band of flannel, into which the chick crept and by rubbing around as it would under its parent's plumage, the dorsal down dried fluffily. There is no doubt that the young bird would never dry well without the constant friction of the old bird's feathers during the first twelve hours after hatching. This condition of the down is apparently a rather serious thing, for when the down dries flat and matted together, it causes such irritation that the little chick wastes much time and strength in trying to preen the bad places. Even a slight thing like this might very well be a matter of life and death, at a time when every moment of learning to correlate eye and beak is of the utmost importance.

I observed that the banging of the incubator door caused instant fear reaction—the chick squatting at once, but no other observations were made until the following day at ten in the morning when it was taken into the compound in a vivarium.

Placed on the ground the *Crypturus* chick twice showed fear reactions, and then perched of its own accord. I worked with it off and on all day, and at last it took four small pieces of worms. On the whole it was far less apt in learning to calculate distances than *Tinamus major* of equal age. This was so marked that I believe it to be another example of very delicate balance between necessity

Fig 22 Three day chicks of *Crypturus variegatus variegatus* (Gmelin) Lateral and dorsal views, natural size. From a color drawing by Isabel Cooper

and practice. In *Tinamus* there is a single adult to look after a brood of six to ten, while the solitary *Crypturus* chick has the whole attention of its parent, so there is far less need for extreme precocity in this case than in the former. With only a single chick to look after, greater care will be taken, and more time devoted to feeding and guiding the offspring. In *Tinamus* the young are compelled to forage more on their own, having the disadvantage of only a fraction of parental solicitude.

Another characteristic peculiar to this species in comparison with *Tinamus* is its relative silence. The other chicks, or even one by itself, were always cheeping or calling, whereas this one utters only very low calls and at infrequent intervals. Even these are given only when the bird is quiet and undisturbed, and seem to be more of the nature of content calls than otherwise. It is readily seen that it is important for a covey of chicks to keep in touch with one another by frequent calls, whereas a single chick following its parent could with safety do so in comparative silence.

The *Crypturus* chick learned the use of its legs and by two P.M. could make its quick, short spurts without falling over at the end. It never walked slowly more than a step or two, but usually after several futile pecks at the bit of worm which I proffered, if it heard a sudden noise, it darted swiftly away for one or two feet and squatted flat. I tested it with various sounds and found that I could cry out loudly, or clap my hands together near it without effect, but the least deep or hollow sound, such as striking the glass side of the empty vivarium, caused it to jump and flatten. Its pecking, as in *Tinamus*, was always forward and downward at the ground, and its constant fault was to strike beyond the object aimed at. The chick was uncomfortable on a white handkerchief and scuttled to bare ground as quickly as possible. It pecked at worms and spiders much more readily on the ground, even when they were of the same color as their surroundings, than when they were laid conspicuously on light bamboo leaves or when held in the forceps.

I tried calls and whistles with no apparent effect, until I imitated the note of *Crypturus* itself. Like a flash the chick turned in my direction, ran six feet toward me, and crouched beside my foot. I tried it again and again, then summoned the members of my staff to watch. The shrillest whistle brought no response, but the very first note on G sharp above middle C, attracted and held the little

bird's attention, and the following notes brought it headlong. After such a reaction it was much more alert and willing to attempt another bit of food, and not only this, but its sense of direction was all but perfect. When I held my face close to the ground and called, the chick ran, not only toward me, but stopped at my mouth, although I had finished calling before it reached me.

This instinctive and perfect reaction to the call of the species, together with its disregard of the call of *Tinamus* and other terrestrial jungle birds, was wholly unexpected. I have known chicks of other groups to crouch instinctively at the cry of a hawk, or the alarm note of their own or other birds, but to recognize among many other imitations, the exact summons call was very interesting, and threw a new light on the instinct reactions of this very generalized type of bird.

It did not enjoy being in the hot sun, but ran with quick darts toward the shade. Like the other tinamou chicks it never showed the slightest fear of our, to it, enormously tall figures stalking about. In fact, if anyone passed while I was attempting to induce it to eat, it invariably rushed off and followed them and had to be brought back and started over again in food interest. Unlike the *Tinamus* chicks no shuffling of hands or feet in scratching motions and sounds had any effect.

Like so many of the small creatures I have watched in the laboratory compound, the chick persisted invariably in working toward the east or north-east. Again and again I turned it about and always it changed direction and started back. I place no special significance at present upon this, but present it as an interesting fact, as applying to mammals, birds, reptiles, amphibians and even to armored catfish. When, however, I gave the parent's call, the chick never failed to turn and run toward me, regardless of direction.

While it learned to peck and swallow bits of food and quartz with fair accuracy, I could not give it the constant attention and encouragement which it needed, and it died on the third day.

THE MEMBRAČIDAE OF KARTABO[1]
BARTICA DISTRICT, BRITISH GUIANA.

7ITH DESCRIPTIONS OF NEW SPECIES AND BIONOMICAL NOTES.

BY MAUD D. HAVILAND (MRS. H. H. BRINDLEY).
Lately Fellow of Newnham College, Cambridge.

(Fig. 23; Plates I–VI incl.)

OUTLINE.

INTRODUCTION.

In 1922, by the courtesy of the Director, Mr. William Beebe, I spent five months at the Tropical Research Station of the New York Zoological Society at Kartabo, on the Mazaruni River, in British Guiana, and during that time, I made some studies of the Membracidae of the district.

The collecting area, which was confined chiefly to a distance of two miles inland from Kartabo Point, included cassava plantations and clearings, mangrove swamp and forest. Most of the forms described here were taken by myself; but a few species, previously obtained at the Station, have been included. These are marked in the following pages with an asterisk. The determination of certain examples presented difficulties, as the types of the older writers were not always available, and I have been obliged sometimes to rely upon the identifications of others in the collections of the British Museum and of Oxford.

The types of the new species described here are in the British Museum of Natural History.

[1] Contribution, Department of Tropical Research No. 192.

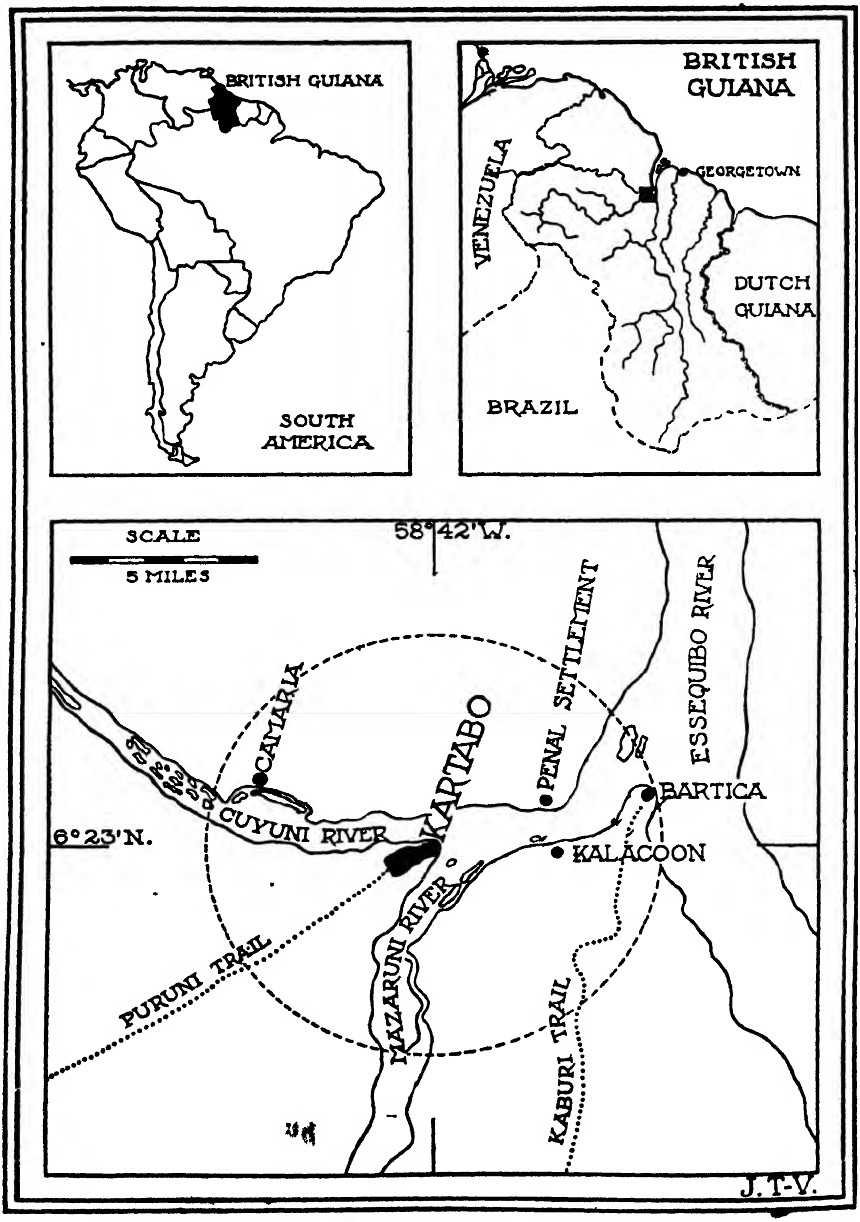

Plate A. British Guiana Tropical Research Station of the New York Zoological Society
Circle represents a radius of six miles.

The synonymy of each species makes no pretension to completeness, but indicates merely where an earlier description can be found.

My thanks are especially due to the Royal Society for a grant enabling me to visit South America; to the authorities of Newnham College for leave of absence during the last three months tenure of my Fellowship; and to Mr. William Beebe for permission to work at the Station, and for much kindness during my stay there.

I must also express my obligations to Mr. Funkhouser of the University of Kentucky, who has examined many specimens for me and compared them with the types of neotropical Membracidae in his collection; and to Dr. Hugh Scott of the University of Cambridge (England) who has given me much valuable assistance on taxonomical points while writing this paper.

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The Zoological Laboratory, Cambridge (England)

LIST OF SPECIES

Found at Kartabo Point, Bartica District, British Guiana

Membracis arcuata (Oliv.).

Membracis arcuata, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 247, 1846.

In the nymphal stages, this species is gregarious, and resembles *M. tectigera*, *M. c-album*, etc. The adult is often solitary, and is rather sedentary, feeding on the young shoots of low shrubs in light trails and clearings.

Membracis c-album Fairm.

Membracis c-album, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 244, 1846.

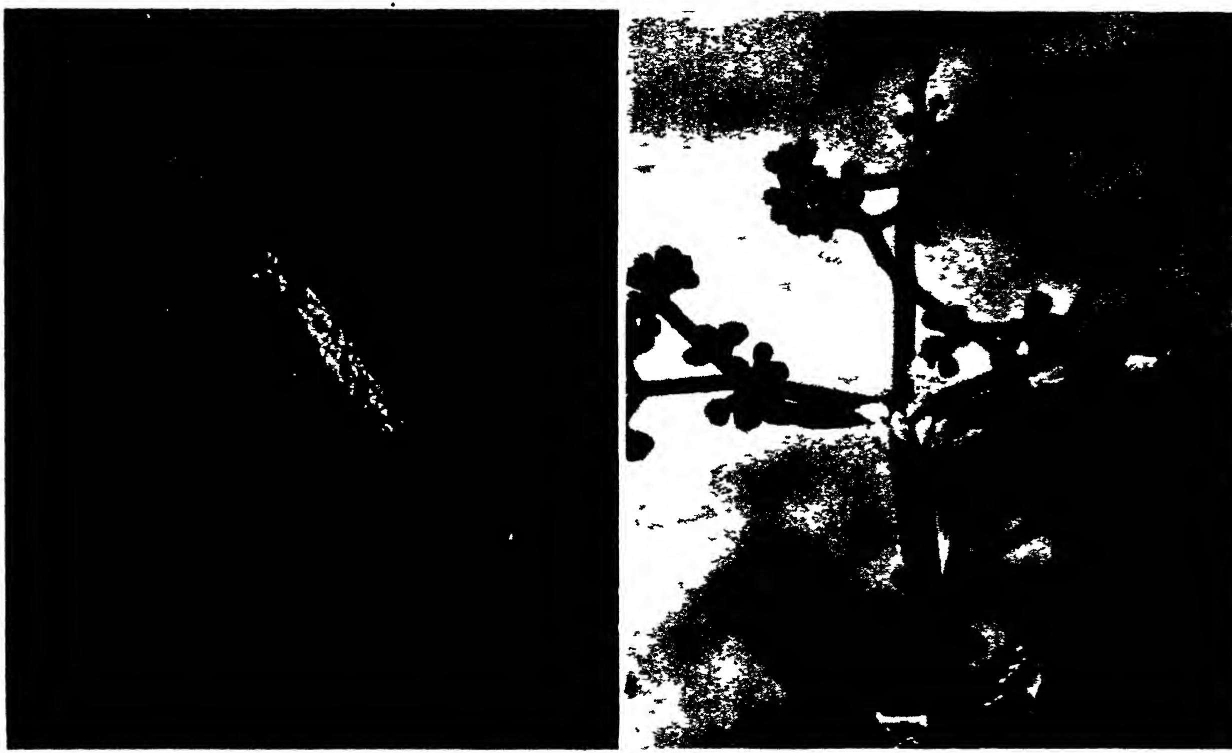
(Pl. VI, fig. 9, nymph.)

This species appeared from time to time between June and September, and is apparently gregarious at all stages. Colonies of the adults and mealy white nymphs occur on the twigs of trees and shrubs of various kinds in open places. The adults are rather sluggish, and when disturbed soon return to their original position.

Membracis carinata (Fabr.).

Membracis carinata, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 244, 1846.

One example (female) taken 6–IX–1922, on low foliage in an open place in the forest.



a *b*

Fig. 23.—*a*, Colony of *Enchenopa lanceolata*; *b*, Nymphs of *Membracis tectigera* on *Vismia ferruginea*

Membracis fasciata (Fabr.).

Membracis fasciata, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 245, 1846.

One male, collected at the Station, 3–I–21.

Membracis fusca de Geer.

Membracis fusca, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 244, 1846.

A few examples were taken early in June, in the middle of the rainy season, after which no more were obtained until September, when they appeared in numbers on a flowering tree which provided several other species of Membracidae. The form of the nymphs and general habits resemble those of *M. c-album*, and *M. tectigera*. There is considerable variation in size, but this does not appear to be altogether a sexual character.

Membracis humilis Fowler, var.

Membracis humilis, Fowler, *B.C.A.*, *Homop.*, II, *p.* 6, 1909.

One female specimen (no date) collected at the Station. The white fascia on the metopidium is absent.

Membracis tectigera (Oliv.).

Membracis tectigera, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 246, 1846.

Common from June to September on trees and shrubs in open places, and resembling *M. c-album* in its mealy young, and gregarious habits at all stages. One example was taken from the web of a spider. The males are considerably smaller than the females, but the latter vary a good deal in size, and many are not larger than the males. A variety taken at the Penal Settlement in 1917 is pale fawn colour, and lacks the white band on the metopidium.

Enchenopa albidorsa (Fairm.).

Enchenopa albidorsa, Walker, *List Homopt. Ins. Brit. Mus.*, *p.* 481, 1850.

Three females taken at the end of July, in the shade of the forest.

Enchenopa bifenestrata Funkh.

Enchenopa bifenestrata, Funkhouser, *Journ. N. Y. Ent. Soc.*, XXX, *No.* 1, *p.* 1, 1922.

(Pl. I, fig. 4, eggs. Pl. VI, fig. 2, nymph.)

I am indebted to Mr. Funkhouser for determining this species by comparison with his types.

It was a small, inconspicuous form, common on the twigs of *Vismia* and other woody plants in the clearings. The egg-cases are flat, brown, scale-like objects. (Pl. I, fig. 4.) Oviposition took from one to three days, and the female frequently remained seated upon the eggs after the process was completed. This species was social, and often occurred in company with *Tragopa* and *Horiola* spp., sharing with them the visits of ants.

Enchenopa lanceolata (Fabr.).

Enchenopa lanceolata, Walker, *List Homop. Ins. Brit. Mus.*, *p.* 481, 1850.

This species was common on the bank of the river near the Station, but seemed to be confined to one host plant, a herb of the order Scrophulaceae with

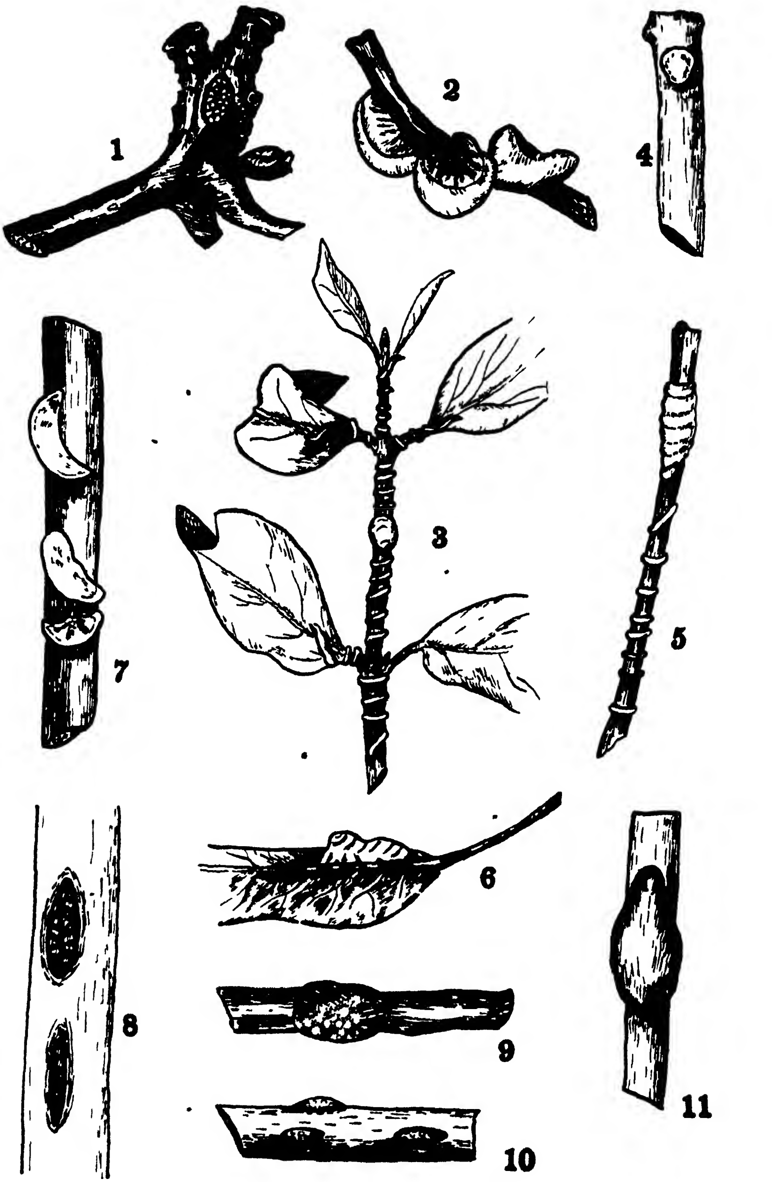


Plate I.—Egg-clusters of, 1, *Tropidocyta gibbosa*, de Geer ; 2, *T. bulbosa;* 3, *T. pruinosa* 4, *Enchenopa bifenestrata*, Funkh ; 5, *Leioscyta spiralis;* 6, *Campylenchia nutans*, Germ 7, *Bolbonota aspidistrae;* 8, *Endoiastus productus*, Osborn, 9, *Aconophora compressa*, Walk. 10, *Lophyraspis armata;* 11, *Aethalion reticulata*, Linn.

large, greenish-white flowers. The eggs of the Membracids were laid in masses of twenty to twenty-five together in punctures in the epidermis of the stem, and were covered externally with a glistening, white deposit of froth-like wax. The adults did not remain upon the eggs, as is the habit of *Enchenopa bifenestrata* and others of the genus. The eggs hatched in five to six days. The nymphs were white and mealy at every stage, unlike those of the northern form, *E. binotata* Say, which, according to Matausch (*Journ. N. Y. Ent. Soc.*, XX, *no.* 1, 1912) lose the white coat after the second moult. They were plentifully attended by ants, in this respect again differing from the allied form (Funkhouser, *Journ. Econ. Ent.*, 8, *June*, 1915). I made considerable collections and records of the development of this species, but my observations as to the number and form of the different instars agree so nearly with what has been written by the authors just cited that it is unnecessary to include them here. The duration of the nymphal stages is discussed elsewhere in a more general connection. The last ecdysis is very striking. The skin splits longitudinally along the dorsum, and the perfect insect, soft and pale, creeps out, leaving the moulted skin attached to the stem by the fore-legs. At first the anterior and posterior processes of the pronotum are equal in size, their axes lying parallel to the long axes of the body; but within seven to ten minutes, literally under one's eyes, the frontal horn elongates, erects itself, and takes on the distinctive form and curvature of the adult, although it requires another two hours or so for the chitin to become black and hard.

Enchenopa monoceros (Germ.).

Enchenopa monoceros, Amyot et Serville, *Hemip. Hist. Nat. Ins.*, *p.* 535, 1843.

Four females taken together on the flowering twigs of a leguminaceous tree in a clearing, August 8, 1922.

These examples vary considerably in depth of colour.

Enchenopa pulchella Funkh.

Enchenopa pulchella Funkhouser, *Journ. N. Y. Ent. Soc.*, *No.* 1, *p.* 2, 1922.

Four examples taken in August, all obtained by sweeping in the low herbage of a cassava clearing near the Station.

One of these (female) has the pronotum unicolorous golden orange, with a black-edged dorsal carina.

Campylenchia nutans (Germ).

Enchenopa (*Campylenchia*) *nutans*, Fowler, *B.C.A.*, *Homopt.*, *II*, *p.* 12, 1909.

(Pl. I, fig. 6, eggs. Pl. VI, fig. 3, nymph.)

This form was taken sparingly in June, on a small straggling tree with reddish bark which was common in clearings near the Station. The egg-masses, on which the females remained seated, were elliptical waxy bodies, deposited on twigs and on the under sides of leaves. The species was attended by ants. The horn varies considerably in size and curvature, but this is not apparently a sexual character. The nymphs are a bright chestnut brown, furnished on the dorsum with two pairs of long, black, divergent spines. The extremity of the

anal tube is provided with a pair of even longer spines, which project outwards at right angles to the long axis of the body. I can throw no light on the function of these curious appendages.

Tropidocyta bulbosa, sp. nov.

(Pl. I, fig. 2, Pl. II, fig. 3, Pl. VI, fig. 8.)

Head sooty brown, clothed with thick yellow pubescence, much longer than wide; margins of genae foliaceus; clypeus spatulate, margin somewhat foliaceus, rounded at the apex; eyes brown; ocelli yellow, small, nearer to each other than to eyes, and situated on a level with the upper margins of the eyes.

Pronotum pitchy brown, thickly covered with yellow pubescence; convex in front, not produced into an eminence or horn; humeral angles sub-triangular, blunt; a transverse sulcus above each eye; median carina strongly percurrent; on either side a well-marked lateral ridge extends from the apex of the metopidium over the shoulders to the middle of the posterior process where it terminates in a shallow depression, and another slight depression lies behind the shoulders; posterior process acute, tectiform, not reaching to the tip of abdomen.

Tegmina opaque, brown, sub-hyaline at the apex; veins brown, broad and very hirsute; three discoidal cells.

Underparts and legs pitchy brown; hind tibiae strongly spined; tarsi yellow.

Long. 3.0 mm. Lat. 1.75 mm.

Type: Female. Sexes alike.

This species is allied to *T. minuta* Funkh., but Mr. Funkhouser, who has compared examples from Kartabo with the types in his possession, considers it distinct.

T. bulbosa is a small, dark, globose insect, which in the field has the facies and habits of a Bolbonota. It was taken in June and July on foliage in the trails in company with *B. aspidistrae* and the eggs were found in July on the twigs of a flowering shrub in a clearing near the Station. The egg masses are of the same type as those of *B. aspidistrae*, but are thicker, whiter and more definitely cup-shaped.

Under the microscope, this nest is a beautiful object, and is very large for the size of the insect. The eggs, to the number of twelve to fifteen, lie in the plane of the long axis of the parent's body, and are arranged radially in a semicircle. The colleterial secretion issues in the form of a lustrous white thread of waxy material, which is wound and piled around and over the eggs in an elaborate manner to form a cup in which the female sits, freely attended by ants. These egg-masses sometimes occur singly, but more often in clusters, and formed quite conspicuous objects against the dark bark.

Two females and a male of the series differ somewhat from the description given above, without meriting specific rank. They are smaller (Long. 2.5 mm.; Lat. 1.5 mm.) and darker in colour. The median carina is ferruginous, and an additional small carina extends over the shoulder. The tegmina are dark and less hairy than in the type form; the apical areas are clear hyaline, and there is a conspicuous clear spot at the apex of the clavus.

Tropidocyta gibbosa (de Geer).

> *Cicada gibbosa* de Geer, *Mem. V.*, p. 211, 1775.
> *Membracis bicristata* Fairmaire, *Ann. Soc. Ent. Fr.* 2, IV, p. 256, 1846.
> *Tropidocyta gibbosa*, Stal, *K. Sven. Vet-Akad. Handl.* 8, p. 45, 1869.
> ? *Tropidocyta albipes* Funkhouser, *Journ. N. Y. Ent. Soc.*, XXX, no. 1, p. 4, 1922.

(Pl I, fig. 1, eggs.)

The figures and descriptions of de Geer and Fairmaire leave little doubt that this is the form whose synonomy is given above.

This species is of interest as being the only Membracid in the collection from Kartabo which invariably caused a definite local deformity of the host plant. It was found in August, in dark places in the forest, on a certain straggling shrub with waxy pink flowers which were borne in a loose inflorescence. While still in bud, this inflorescence was attacked by *T. gibbosa.* It became distorted and lignified; and the bud that it bore shrivelled and fell off. The eggs in masses of forty to fifty together were laid on this deformed stump. The adults and nymphs, attended by ants, clustered upon it and were never observed to feed on any other part of the plant.

Tropidocyta neglecta, sp. nov.

(Pl. II, fig. 4.)

Head pitchy black, thickly beset with golden pubescence, longer than wide; margins of genae sinuate, acutely lobed at the apex; clypeus sub-triangular, foliaceus, projecting for more than half its length beyond genae; eyes brown; ocelli yellow, small, inconspicuous, twice as far from one another as from eyes, and situated on a level with the upper margins of the eyes.

Pronotum dark ferruginous brown, roughly sculptured, pubescent, not punctate, sub-angulate in front, not produced into a horn. Metopidium about as wide as high, furnished with a strong percurrent carina which is ferruginous brown, high and sharp; posterior process acuminate, somewhat compressed laterally at two points behind the middle, slightly depressed at the apex, not reaching tips of tegmina; on either side a strong lateral carina extends obliquely over the shoulder to the margin behind the base of the tegmen.

Tegmina brown, opaque, punctate at the base, paler at the apex; veins very pubescent; three discoidal cells.

Long. 4.5 mm. Lat. 2.0 mm.

Type: Female.

One example taken on *Vismia ferruginea* by sweeping, 2–IX–22.

Tropidocyta pruinosa, sp. nov.

(Pl. I, fig. 3; Pl. II, fig. 5.)

Dark purplish brown, punctate; head, prothorax and underparts thickly clothed with silvery pubescence, which gives the insect a frosted bloom.

Head about as long as wide; margins of genae semi-foliaceus, lobed; clypeus foliaceus, broad and rounded at the apex, which projects considerably beyond

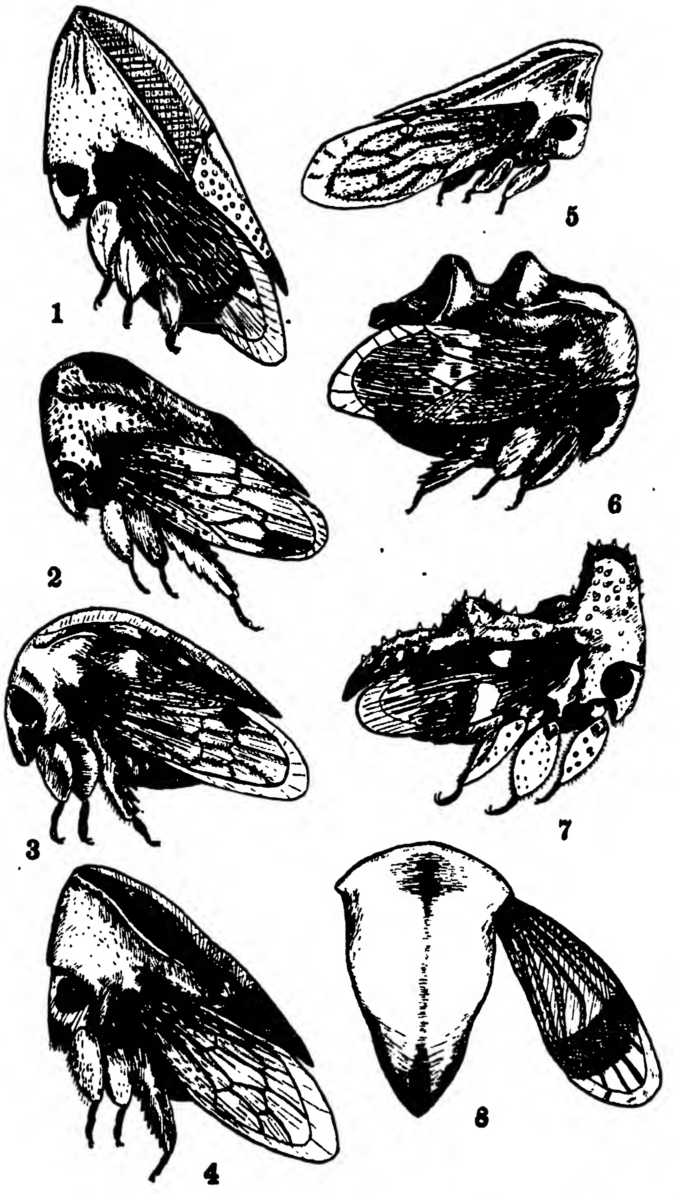


Plate II.—1, *Leioscyta beebei*; 2, *L. spiralis*; 3, *Tropidocyta bulbosa*; 4, *T. neglecta*; 5, *T. pruinosa*; 6, *Bolbonota aspidistrae*; 7, *Hypsoprora aspera*; 8, *Rhexia kartabensis*.

margins of genae; eyes yellowish grey, rather prominent; ocelli amber colored, nearer to the eyes than to the median line, and situated on a level with the centres of eyes.

Prothorax furnished with a very short, conical, blunt horn slightly recurved at the apex; anterior border straight; metopidium traversed by a faint, median ridge; humeral angles rounded, not prominent; posterior process narrow, acuminate, just reaching the tip of abdomen, and furnished with a sharp, percurrent carina; a pair of lateral carinae on each side, the superior, which is sharp and strongly marked, extends from the tip of the frontal horn to the margin of the posterior process, half way to the apex, the inferior is less pronounced and extends from the metopidium to the humeral angles; edges of the carina black, the intervening spaces heavily clad with white pubescence; tegmina entirely free, brown, opaque, and with a velvety bloom; a small sub-hyaline spot at the base of the internal apical cell; veins very broad, raised, and together with the basal areas of the corium and clavus, clothed with white, silky hairs; one discoidal and five oblong, narrow, straight, apical areas.

Legs pale, sordid yellow; tibiae scarcely foliaceous, the hind pair furnished with row of spines; tarsi tipped with black.

Long. 5.4 mm. Lat 2.0 mm. Tegmen: 5 0 mm.

Type: Female.

This species is very distinct. It has the facies of a *Tropidocyta*, and in spite of the non-foliaceus legs and the single discoidal cell, should probably be placed in this genus, for the venation is obscure, and as the description is based on a single example, the disappearance of a cross vein may be an individual abnormality.

This species was rare at Kartabo. In the beginning of June, my attention was attracted by white, spiral threads of some viscous or waxy substance, twined round the twigs of shrubs, five or six feet above the ground; but it was not until the 26th of the month that I recognized these as the unfinished nurseries of this Membracid. The thread is wound many times above and below the egg-case, which is a lenticular, glistening, white body, in which the eggs are embedded. The female sitting upon this egg-mass was not attended by ants. The purpose of the thread is not known. It may be a protection against predatory enemies, but after removal of the female, I kept the nest under observation for some time, and on the following day found that it was invaded by ants, although the thread was intact. The egg-case gradually disintegrated; only two nymphs were hatched, and these disappeared a day or two later.

The number of nests of this elaborate plan that were left uncompleted is striking; for early in July, I found two more, but neither searching nor sweeping produced another example of the Membracid.

Leioscyta beebei, sp. nov.

(Pl. II, fig. I.)

Head ochreus, shaded with dark brown; margins of genae arcuate and acutely lobed below; clypeus lobed at its articulation with genae, and with the free margin foliaceus and broadly rounded; eyes grey; ocelli yellow, equidistant between the eyes and the median line, and situated just above the level of the centres of the eyes.

Pronotum testaceous yellow, punctured densely in front and more coarsely behind, obtusely angular, not horned at the frontal apex; metopidium high, perpendicular, furnished with a carina which is strong and percurrent on the dorsum; humeral angles not prominent; a strong lateral carina on either side extending from the metopidium to the pronotal margin half-way to the apex of the posterior process; three, faintly marked ridges on either side of the metopidium, below and in front of the lateral carina; posterior process acuminate, not quite reaching tip of abdomen, white, black at the apex, and furnished with a bright, chestnut spot on the dorsum between the lateral carinae.

Tegmina chocolate, with a yellow, sub-hyaline patch at the apex. Abdomen, underparts and legs ferruginous black; tarsi yellow.

Long. 5.0 mm. Lat. 2.0 mm. Tegmen: 4.25 mm.

Type: Female. Sexes alike.

A male and female collected at the Station 29–X–20.

I have much pleasure in naming this species after Mr. William Beebe, Director of the Tropical Research Station at Kartabo.

Leioscyta spiralis, sp. nov.

(Pl. I, fig. 5, Pl. II, fig. 2.)

Head ochreus brown, finely punctate, clothed with silky white pubescence, longer than wide; margins of genae foliaceus; clypeus foliaceus, rounded laterally, and with the apex truncate; eyes brown; ocelli yellow, rather large, nearer to the eyes than to one another, and situated on a level with the upper margins of the eyes. Pronotum sordid ochre, clouded with umber brown, paler behind, punctate, pubescent; metopidium carinate, sloping, rounded at the summit, not furnished with an eminence or horn; humeral angles sub-triangular, not produced; posterior process roughly sculptured, coarsely punctate, very acute, just reaching to the tip of the abdomen; median carina high, sharp, and percurrent; on either side, a strong curved lateral carina extending from the summit of the metopidium over the shoulders to the lateral margin of the posterior process, two large spots on the dorsum and the apex of the posterior process, chocolate brown.

Tegmina brown, coriaceous and opaque at the base, and with a dark spot at the apex; veins pale brown, broad and hirsute.

Underparts dark brown, pubescent; tibiae sordid yellow.

Long. 6.0 mm. Lat. 3.5 mm. Length of Tegmen: 6.0 mm.

Type: Female.

This species resembles the type of *Enchenopa quadricolor* Walk. in the British Museum, but differs in the stouter form and position and curve of the lateral carinae. This, the only example obtained, was taken from a curious egg-mass of the type of that of *Tropidocyta pruinosa.* The eggs themselves were embedded in an imbricated, brown, waxy mass, and the twig below was encircled about a dozen times with a white viscous thread. During the time that the nest was under observation, it was not visited by ants, but I found by experiment that the thread was no bar to these insects, which were running in numbers over the tree.

Bolbonota aspidistrae, sp. nov.

(Pl. I, fig. 7, Pl. II, fig. 6, Pl. VI, fig. 1.)

Head black, with golden pubescence, much longer than wide; genae acutely lobed at the apex; clypeus foliaceus, lozenge-shaped, with angles sub-acute; base of head convex and rather prominent; eyes dark brown; ocelli translucent, twice as close to eyes as to each other, and situated on a level with upper margins of eyes.

Prothorax bronze black, pubescent, punctate, highest between shoulders, with humeral angles conical, blunt and prominent; dorsum furnished with two tubercles of equal size; the anterior conical, and not laterally extended; the posterior strongly carinated and extended transversely to the lateral margins of the pronotum. A percurrent, median carina extends over the metopidium and tubercles to the apex of the posterior process, which is sub-acute, roughly sculptured and not especially depressed. A strong, semicircular, lateral carina extends backwards from the metopidium on each side of the anterior tubercle.

This species is variable in colour. In some examples the whole insect is deep, sooty black, and the tegmina are black and opaque, occasionally spotted with white, and hyaline at the apex. In others, the genae and clypeus are bordered with ochreous; the prothorax and abdomen are ferruginous; the dorsum, including the carina, tubercles and apex, and the legs are ochreous yellow. In such a case the tegmina are ferruginous, marked conspicuously with white and yellow.

Long. 3.0 mm. Lat. 2.0 mm.

Type: Female. Sexes alike.

This species, like *B. corrugata*, *B. inaequalis* and *B. pictipennis*, was common in the more open, forest trails on the upper surface of leaves of *Aspidistra* and other plants. All these forms readily take wing, but are otherwise well protected, owing to their resemblance to small pieces of bark and withered buds which fall in profusion from the foliage overhead.

In July, I found a small colony breeding on a shrub beside a trail. The nests are crescentic, white structures, hollow above, and usually placed two or three together at the base of a petiole. The female sits in the concavity until the brood is hatched, unless accidentally disturbed, and if she departs, she does not find her way back again. The nymphs are dull green and active. Soon after hatching, they crawl up the stem and feed on the under side of the leaves on the mid-rib. The nesting females and nymphs are visited by swarms of ants, which muster to the attack if the plant is shaken, but the free-living adult Membracids, probably owing to their restless habits, are never thus attended.

A small series in the Hope Museum at Oxford is labelled in Canon Fowler's handwriting as *Tylopelta gibbifera* Stal. It is undoubtedly near to *B. aspidistrae*, from which it differs in its smaller, more elongate form, and in the less prominent humeral angles and carinae. I am unable to trace this species unless it is identical with *Tropidocyta gibbera* Stal. which Fowler (*B.C.A.*, p. 15) removed to his new genus *Tylopelta*, but it does not altogether correspond with the descriptions of that form.

Bolbonota corrugata Fowler.

Bolbonota corrugata Fowler, *B.C.A., Homopt.* II, *p.* 19, 1909.

Two examples among a series of *B. aspidistrae* obtained in the forest, June 26th, 1922.

Bolbonota inaequalis (Fabr.).

Bolbonota inaequalis, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 259, 1846.

Two females taken by sweeping in the forest, June 14th, 1922, and a third, and two nymphs of the last instar, obtained on a twig in rather a dark place in the forest, July 1st, 1922. The nymphs were covered with mealy white powder, and were attended by ants.

Bolbonota pictipennis Fairmaire.

Bolbonota pictipennis Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 258, 1846.

One female taken by sweeping in the forest, Sept. 22nd, 1922, and determined by comparison with the series in the British Museum.

Pterygia uropygii Buckt.

Pterygia uropygii Buckton, *Monograph of the Membracidae, p.* 72, 1903.

One female was taken on leaves in the forest, July 24th, 1922.

This remarkable form is a very beautiful object under low power of the microscope, the spines along the dorsum and lateral horns being touched with purplish pink.

Stoll figures what is evidently meant for this species (Cic., fig. 8) under the title "Het Kruis," or "The Cross."

Sphongophorus guerini Fairmaire.

Sphongophorus guerini Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 262, 1846.

This species was solitary, and not uncommon on shrubs and low foliage in the clearings. It was rather sluggish, and could easily be caught by hand. According to my observations, it was never attended by ants.

Hypsoprora aspera, sp. nov.

(Pl. II, fig. 7.)

Head covered with white encrustation, punctured with black, rather longer than wide; margins of genae straight, acutely lobed at apices; clypeus extending far below genae, spatulate, with the free margin slightly rounded and pilose; eyes grey and prominent; ocelli grey, twice as far from each other as from eyes, and situated on a level with the upper margins of the eyes.

Prothorax rugose, black, profusely decorated with white, punctured and studded with small spines; furnished with a stout, erect, frontal horn, which is truncated, not compressed, and carinated at the apex; posterior process long, carinate, much compressed laterally, with the apex blunt and decurved, reaching the tips of the tegmina; dorsum provided with two tubercles, a small one at the base of the frontal horn, and a large, rounded protuberance behind it. On either side of the latter is a strong, lateral ridge, which extends to the apex of the posterior process.

Tegmina chocolate brown, black and punctate at the base and decorated with white patches on the claval and costal margins; venation somewhat obscured.

Abdomen and underparts black, decorated with white; femora and tarsi black; tibiae very foliaceus, white and punctate.

Long. 5.50 mm. Lat. 2.50 mm. Alt.: 3.50 mm.

Type: Female.

This form is very close to *Hypsoprora* (*Pterygia*) *pileata*, Fairm.

A single example was taken by sweeping in a clearing, July 23rd, 1922.

Aconophoroides gladiator (Walk.).

Aconophoroides gladiator, Fowler, *B.C.A.*, *Homopt.*, II, *p.* 48, 1909.

This species seemed rather scarce at Kartabo. Three examples were taken at the beginning of June, and another male in September, in every case on the reddish bark of a shrub of species undetermined.

On once occasion a specimen had just been captured by a spider.

The horn of the male is much shorter than that of the female, and may be almost obsolete.

* *Umbonia spinosa* (Fabr.).

Umbonia spinosa, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 276, 1846.

Four specimens taken at the Station, August 16th, 1922.

Darnis latior Fowler.

Darnis latior Fowler, *B.C.A.*, *Homopt.*, II, *p.* 52, 1909.

Single individuals were found occasionally in the darker parts of the forest, feeding in the axils of the leaves of herbaceous plants.

Darnis partita Walk.

Darnis partita Walker, *Ins. Saunders.*, *Homopt.*, *p.* 75, 1850.

More common than the last, and fed in the axils of leaves, in lighter parts of the forest. Usually it occurred singly, but occasionally two individuals were found together.

Stictopelta indeterminata (Walk.).

Stictopelta indeterminata, Fowler, *B.C.A.*, *Homopt.*, II, *p.* 59, 1909.

Three specimens collected at the Station, July 21st, 1922, evidently belong to this species, which, following Fowler, I have included in the genus *Stictopelta*. I am, however, inclined to think that it would be more properly placed in Fowler's own genus, *Hebeticoides*, for the distinguishing characteristics, the contiguity and position of the bifurcation of the ulnar veins, are variable even in the small series of examples that I have had for comparison.

Aconophora compressa Walk.

Aconophora compressa Walker, *List. Homopt. Ins. Brit. Mus.*, *p.* 541, 1850.

(Pl. I, fig. 9, eggs.)

Taken in July and later in August and September, on the stems of a shrub in a shady place. The adults readily take wing, but soon return to their original

position. The egg-cases are brown, elliptical bodies, each containing a score or more eggs, which are embedded in the waxy substance of the case and not inserted in the tissues of the plant. Each female remains seated on her eggs unless disturbed. The long frontal horn appears remarkably like a thorn or broken twig when the insect is seen thus *in situ*, and this character is also well marked in the nymphs. It is of course relatively little developed in the early instars, which are dingy ochreous and black forms; but already by the fourth instar the frontal horn and dorsum are conspicuously marked with bright, ferruginous brown, and the sides of the body are decorated with white, flocculent patches. The nymph of the fifth instar is much more gaily coloured than the adult. The head, wing-cases and underparts are black; the pronotum is bright chestnut, marked heavily along the sides with black, and with a black stripe down the carinated metopidium. The rest of the thorax and abdomen are black, conspicuously variegated with yellow and white, and the legs are black with yellow femora.

The nymphs of every stage are furnished with four pairs of long, black, dorsal spines; the first, on the mesonotum, are somewhat recurved, and project back on either side of the posterior process. The remaining pairs are on the first, second and third abdominal segments. At all stages the nymphs are active and run rapidly down the stem when disturbed. Their long, red-tipped horns give them the semblance of a row of thorns, although the plant on which they were found in this instance is not thorny. They excrete large quantities of "honey-dew," which smears the surrounding foliage, and attracts many ants.

Cymbomorpha vaginata (Germ.).

Cymbomorpha vaginata Stal, *K. Sven. Vet-Akad. Handl* 8, 1, *p.* 34, 1869.

Two females, dated the 15th and 22nd of July, 1922. One had been carried off by a hunting spider.

Rhexia kartabensis, sp. nov.

(Pl. II, fig. 8.)

Head pale green, shining, punctate, sub-triangular, broader than long; genae straight; clypeus small, rounded, hairy at apex, not produced beyond margins of genae; eyes red, prominent; ocelli yellow, twice as far from each other as from eyes, and situated on a level with the upper margins of eyes.

Pronotum pale translucent green, shining, very finely punctured, convex, highest above shoulders, non-carinate; metopidium sloping, twice as wide as high; humeral angles blunt, slightly produced; posterior process sub-acute, much compressed behind shoulders, margin sinuate, not quite reaching apex of tegmina; a dark brown median line from metopidium extending along dorsum; lateral margins and apex of posterior process much suffused with olive green.

Tegmina entirely free, yellowish brown, semi-opaque, with a broad dark band across the distal third and hyaline at the apex; veins pale brown, punctate.

Underparts green; legs yellow; hind tibiae with three rows of small black spines.

Long. 6.0 mm. Lat. 4.0 mm.

Type: Female.

One example taken on foliage in a trail, attended by ants, Sept. 4th, 1922.

Heteronotus armatus Lap.

Heteronotus armatus Laporte, *Ann. Soc. Ent. Fr.*, 1, IV, *p.* 97, 1832.

(Pl. III, fig. 8.)

The Kartabo series has been identified by comparison with specimens determined by Fowler in the Hope Museum, and also with those in the British Museum. *H. confusus* Butl. is possibly a synonym; and Fairmaire is probably right in supposing that *H. spinosus* Lap. is only a pale form of *H. armatus*.

This fine insect was not uncommon round the Station in August and September, but the nymphs were not found. The adults were solitary, and inhabited the edges of clearings. They sat in full view on the upper side of the foliage, and readily took wing with a loud buzzing noise.

I procured examples of two other forms of this genus allied to *H. armatus*, but which do not correspond to any named specimens or descriptions of species to which I have access. Both were taken in the same surroundings, and have the same general facies and habits as *H. armatus*. It is probable that many of the described forms of this type will prove to be varieties of a single species. At present the difficulty of determining examples from brief descriptions, often unsupplemented by figures, is very great.

Heteronotus albospinosus, sp. nov.

(Pl. III, fig. 6.)

Head gamboge yellow with two black stripes. Prothorax armed anteriorly with two, long slender, yellow spines, diverging outwards for the first half of their length and then curved almost to a right angle and directed backwards. Posterior process divided into three nodes or swellings, the first being the smallest, and the second and third nearly equal in size. The third, which is borne at the end of a peduncle equal in length to half the diameter of the node, is furnished with one ventral and two dorso-lateral, slender, backwardly-directed spines. Pronotum ochre yellow, bordered with cream colour. On either side of the metopidium, a black stripe, continuous with the facial stripe, extends obliquely to the lateral margin, where it joins a second black stripe rising behind the eye, and reaches the humeral angle; between the anterior spines, a circular black spot, interrupted by a median yellow line; second and third nodes laterally suffused with black. Spines wholly yellow, with the exception of the posterior dorso-lateral pair which are white for the distal third of their length.

Rest of body and limbs yellow. Tegmina hyaline yellow with black veins.

Length of body to end of abdomen .... 7.5 mm.
Length of body from frons to tip of posterior spines .... 10.0 mm.
Length of tegmen .... 8.0 mm.
Width between tips of anterior spines .... 5.3 mm.

Type: Female.

A specimen in the Hope Museum, collected by Bates on the Amazon in 1861, and labelled "? sp." in Canon Fowler's writing, belongs to this form.

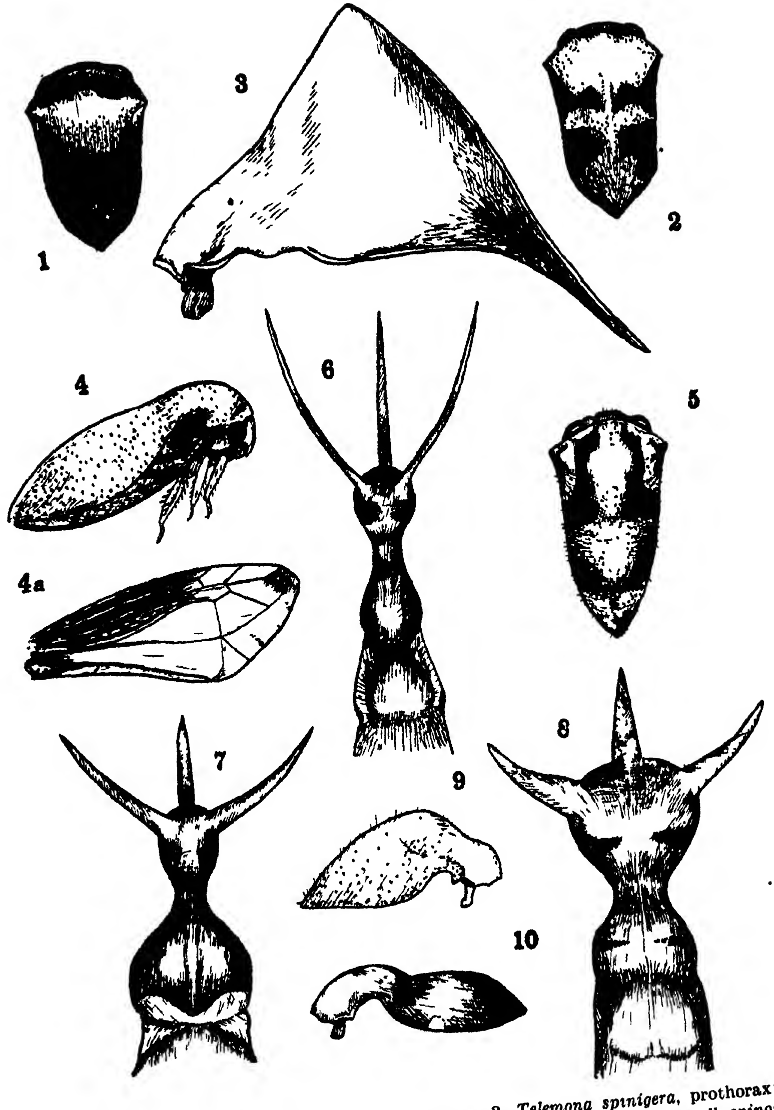


Plate III.—1, *Tragopa occulta*; 2, *T. guianae*; 3, *Telemona spinigera*, prothorax; 4, *Apheles affinis*; 4a, *A. affinis*, tegmen; 5, *Vanduzea testudinea*; 6, *Heteronotus albospinosus*, posterior process; 7, *H vespiformis*, posterior process; 8, *H armarus*, Lap , posterior process, 9, *Amastris funkhouseri*, prothorax; 10, *Boethoos globosa*, prothorax.

Heteronotus vespiformes, sp. nov.

(Pl. III, fig. 7.)

This form is close to *H. divisus*, Wlk., but the peduncle of the posterior node is somewhat differently constructed.

Head gamboge yellow with two black stripes.

Pronotum gamboge yellow, decorated with two, broad, black stripes, which are joined by a transverse band at the base of the posterior process, and are interrupted by a large, cuneiform, yellow spot on either side of the metopidium and by a circular, yellow area round the base of the anterior spines, which are black, stout, and directed slightly backwards. Posterior process ochre yellow, with a low tubercle at the base and two nodes; the first large, black, not constricted in front, rounded behind; the second smaller, oval, arising by a short peduncle not equal in length to half the width of the node, heavily marked with black and furnished with one ventral and two dorso-lateral, stout, almost straight and backwardly diverging spines.

Rest of body and legs yellow; tarsi black.

Tegmina yellowish hyaline, shining, with black basal, and brown apical, veins.

Length from frons to tip of abdomen	8.0 mm.
Length of tegmen	10.0 mm.
Length from frons to tip of posterior spines	10.0 mm.
Width between tips of anterior spines	6.0 mm.

Type: Female.

Tragopa cimicoides (Fabr.).

Tragopa cimicoides, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, p. 485, 1846.

(Pl. VI, fig. 6, nymph.)

Commonly taken from June to September, and showing considerable variation in the amount of black colour on the pronotum. The eggs were laid in clusters of 30–40, in slits in the epidermis of the stems of various woody plants. The females sat on the eggs, and were much visited by ants. When breeding, they were eminently gregarious, so much so that an infested twig looked as if it were crowded with brown berries, or possibly with galls, though I would not go so far as to suggest cryptic resemblance as an interpretation of the peculiar form. When not breeding, the adults tended to solitary habits, and were frequently taken by sweeping in herbage in the clearings.

Tragopa guianae, sp. nov.

(Pl. III, fig. 2.)

Head pale ochreous, spotted with brown, shining, not punctate, not pubescent, twice as broad as long, margins of genae short, slightly arcuate, lobed at apex; clypeus small, the free margin tri-lobed, hairy at the apex, not projecting beyond margin of genae; eyes grey, prominent, and directed laterally; ocelli yellow, nearer to eyes than to each other, and situated on a level with the centres of eyes. Prothorax dirty white in ground colour, finely and densely punctured with brown, and furnished with short, scattered hairs, shield shaped,

excavated behind shoulders, which are rounded and not prominent; metopodium sloping, very much wider than high; dorsum convex, highest in the middle, non-carinate; posterior process blunt, just covering apex of abdomen and tegmina. A chocolate-brown, irregular, transverse band rising behind the shoulders and extending backwards across the middle of the dorsum; behind this on either side a large sub-triangular brown spot; apex of posterior process brown.

Exposed portions of tegmina bright brown, shining, not punctate. Underparts chocolate-coloured, pubescent; legs yellow; tarsi black.

Long. 3.50 mm.

Lat. (int. hum.) 2.5 mm.

Type: Female.

Two females taken in a colony of *Vanduzea testudinea*, August 2nd, 1922.

The resemblance in colour and pattern between the two forms is so close, that without careful examination, they might be mistaken for varieties of the same species.

Tragopa occulta, sp. nov.

(Pl. III, fig. 1.)

Head black, shining, finely and remotely punctate, half as long as wide; margins of genae arcuate; clypeus small, sub-quadrate, and projecting for about half its length beyond genae; eyes dark brown; ocelli yellow, nearer to eyes than to each other, and situated just above the level of the centres of the eyes.

Prothorax convex, black, shining, finely and thickly punctate, destitute of median line or keel; anterior margin rounded; metopidium sloping, highest above shoulders; humeral angles sub-triangular, only slightly produced; posterior process excavated behind shoulders, apex plicate and sub-acute.

Tegmina with the exposed portion coriaceous, black, and thickly punctate. Underparts and legs rusty black.

Long. 4.50 mm. Lat. 2.75 mm.

Type: Female.

One example taken in deep forest, July 5th, 1922.

This form may prove to be merely a dark variety of some species already known.

Tragopa scutellaris Buckt.

Tragopa scutellaris Buckton, *Monograph of the Membracidae*, p 156, 1903

Not uncommon; resembles the last in habits.

Tragopa tripartita Fairm.

Tragopa tripartita, Fairmaire, *Ann Soc Ent Fr*, 2, IV, p 490, 1846.

I am indebted to Mr. Funkhouser for determining this most variable form. At first sight the different variations look like distinct species; but the types of colour and patterns imperceptibly grade into one another, and slight differences of size and proportion are not constant and may occur with any colour combination. The variations are not due to sex.

The principal varieties in the Kartabo collection are:

Var. 1. Entirely bronze black.

Var. 2. Head and anterior part of pronotum pale ochreous brown, with a very broad, transverse band, usually black but occasionally chestnut behind the shoulders, and sometimes with the apex of the posterior process black.
Var. 3. Like the last, but with the median band interrupted on the dorsum.
Var. 4. Like the last, but with the transverse band marked with a lateral testaceous spot, and the apex of the posterior process olive-brown.
Var. 5. Pronotum bright reddish brown, obscurely marked behind the shoulders and across the posterior process with darker brown.

This was a common species taken on *Vismia ferruginea* and other plants, frequently in company with *Tragopa cimicoides* and *Horiola arcuata*. The different varieties were found together in the same colonies. They were always visited by ants, which often built shelters of vegetable fibre over and around them.

Horiola arcuata (Fabr.).

Horiola arcuata, Fowler, *B.C.A.*, *Homopt.*, II, *p.* 86, 909.

A gregarious species which sometimes occurred in considerable numbers, often in association with *Tragopa tripartita* Fairm. It fed on various plants, but especially on the twigs of *Vismia ferruginea*, where it was frequently enclosed in shelters of vegetable fibre which had been built over it by the gnats which always attended it. The eggs were laid in clusters of 30–40 together in slits in the epidermis of the stems.

Horiola ferruginea Fairm.

Horiola ferruginea Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 493, 1846.

One male taken in a colony of *H. arcuata*. I believe this to be Fairmaire's species, although the "tres petite ligne blanchatre" at either side of the extremity of the posterior process is replaced in my specimen by a minute white spot.

Boethoos cinctata, sp. nov.

(Pl. IV, fig. 5.)

Head chestnut brown, polished, not punctate, with scattered hairs, surface somewhat irregular, sub-triangular, about as long as wide, projecting forwards; margins of genae oblique, somewhat plicate and extroverted; clypeus small, not extending below genae, tip blunt and thickly hairy; eyes brown, prominent; ocelli yellow, equidistant from each other and from eyes, and situated just below the level of the centres of the eyes.

Pronotum bright chestnut brown, with metallic lustre, punctate, thickly hairy, with a broad transverse gamboge-yellow band over the dorsum behind the shoulders, convex, with the median carina faintly marked; metopodium sloping, wider than high; humeral angles sub-triangular, not much produced; posterior process excavated, and somewhat compressed behind shoulders; lateral margin sinuate; apex rounded.

Tegmina hyaline, with thick dark veins and two infuscated patches at the apex.

Underparts and legs light brown, shining, and rather pubescent.

Long. 7.0 mm. Lat. 3.5 mm.

Type: Female.

One example collected in a clearing, August 15th, 1922.

A second female in Mr. Beebe's collection, dated July 15th, 1922, is evidently of the same species, but the transverse band is faint sordid yellow.

Boethoos distinguenda Fowler.

> *Parmula distinguenda* Fowler, *B C A*, *Homopt*, II, *p* 91, 1909
> *Parmula* = *Boethoos*, Kirkaldy, *Ent*, 37, *p* 279, 1904

Somewhat scarce. Single individuals were found breeding in August and September near colonies of *Tragopa cimicoides*, and other social forms, with whom they shared the attentions of ants.

Boethoos globosa, sp. nov.

(Pl. III, fig. 10.)

Head ferruginous brown, shining, faintly punctate, wider than long, projecting forwards; margins of genae arcuate, produced and extroverted, bordered with yellow; clypeus small, rounded, not projecting beyond genae; eyes grey and prominent; ocelli grey, twice as far from one another as from eyes, and situated on a level with the centres of the eyes.

Pronotum ferruginous brown, polished, finely punctate, slightly pale behind, highest above shoulders; metopidium convex, sloping, twice as wide as high; humeral angles sub-triangular, bordered with yellow; posterior process tectiform, slightly carinate, sub-acuminate, depressed transversely behind shoulders; a bright yellow spot at the middle of the lateral margin on either side.

Tegmina yellowish brown, semi-transparent, the proximal discoidal cell infuscate; veins broad, dark, punctured at the base.

Abdomen short and globose; underparts and legs ferruginous; tibiae decorated with yellow; tarsi black.

Long. 3.50 mm. Lat 1.75 mm.

Type: Female.

A small reddish brown shining globose species, taken August 5th, 1922, among a colony of *Horiola arcuata* which had been partly covered with vegetable fibre by ants.

Boethoos reticulata (Fabr.).

> *Parmula reticulata*, Stal, *K Sven Vet-Akad*, *Handl*, 8, 1, *p*. 29, 1869
> *Parmula* = *Boethoos*, Kirkaldy, *Ent*, *p* 279, 1904.

(Pl. VI, fig. 7, nymph.)

Small colonies were found on June 28th, 1922, and on August 4th, 1922, in each case completely enclosed by ants under a shelter of vegetable dust. Early in September, broods appeared on a flowering leguminaceous tree in a clearing which seemed to be attractive to Membracidae, for other forms, such as *M. fusca* and *M. c-album* and *E. monoceros*, etc. were taken upon it. Here, although ants swarmed over the tree and visited the different Membracid colonies, *B. reticulata* lived free, and uncovered. There is considerable variation in the depth of the

ground colour of the pronotum, and in the extent and continuity of the markings, but my collections show that this is not dependent on whether or no the species is covered up by ants.

Vanduzea testudinea, sp. nov.

(Pl. III, fig. 5.)

Head greenish yellow, marked with brown, polished, shining, sparingly pubescent and punctate; base somewhat sinuate; genae rounded, with margins extroverted; clypeus very small, rounded, not projecting beyond genae, hairy at the apex; eyes yellowish grey; ocelli yellow, nearer to margins of eyes than to each other, and situated on a level with the centres of the eyes.

Prothorax sordid white, pubescent, densely punctured with brown, convex, highest above shoulders; humeral angles blunt, not prominent; median carina very slight; metopidium sloping, wider than high; posterior process blunt, tectiform, excavated behind the shoulders, not quite reaching tips of the tegmina. A narrow band along the anterior margin, borders of humeral angles, and apex of the posterior process brown. A broad, irregular, dark brown band extending over the metopidium on either side, often confluent in the middle of the dorsum behind the shoulders, and then turning at an obtuse angle to the lateral margin; a second transverse brown band extending across the dorsum half-way to the apex of the posterior process.

Tegmina hyaline; with a dark, clouded spot in the middle, and another at the apex; veins black and boldly marked.

Underparts brigh brown; legs brown, spotted with yellow.

Long. 4.0 mm. Lat. 2.0 mm.

Type: Female. Sexes alike.

A small series taken August 19th, 1922, on *Vismia ferruginea*, where they were attended by ants, which had built a slight shelter of vegetable fibre round them.

Amastris elevata Funkh.

Amastris elevata Funkhouser, *Journ N. Y. Ent. Soc*, XXX, *no.* 1, *p.* 27, 1922.

(Pl. VI, fig. 5.)

This form, which Mr. Funkhouser has kindly determined for me by comparison with his type, is evidently near to *A. obtegens* Fabr. It is a bright green shining species, taken in July and August on a coarse, green herb in a clearing close to the Station. The eggs are laid in clusters of 30–40 in the epidermis of the stem. The nymphs are green; and as they feed flattened close to the petioles and mid-ribs of the leaves, they are almost invisible to a casual glance. Their presence, however, is often betrayed by the swarms of ants which attend them.

Amastris funkhouseri, sp. nov.

(Pl. III, fig. 9.)

Head pale green, roughly sculptured, punctate, coarsely pubescent, about as long as wide; margins of genae sinuate; clypeus small, hairy, not extending

much beyond genae; eyes pink; ocelli bright red, equidistant from each other and from eyes, and situated on a level with the centres of the eyes.

Pronotum greenish yellow, obscurely marked with orange, roughly sculptured, punctate, hirsute; metopidium wider than high, perpendicular, convex, w th a faint yellow keel; humeral angles blunt, little produced; dorsum rising abruptly behind the shoulders in a high carinate ridge which slopes backwards and downwards to the apex of the posterior process, which is sub-acute, tectiform, laterally compressed, somewhat excavated behind shoulders, and just reaches the apex of the tegmina.

Tegmina yellowish hyaline, punctate along the costa and at the base; veins pale brown.

Abdomen orange; underparts and legs yellow; tarsi black.

Long. 4.2 mm. Lat. 2.0 mm.

Type: Female.

One female taken by sweeping in a clearing, September 4th, 1922. I have much pleasure in naming this species after Mr. W. D. Funkhouser of the University of Kentucky, in recognition of his assistance in the determination of this and other specimens.

Amastris vismiae, sp. nov.

(Pl. IV, fig. 4.)

Head yellowish brown, shining, faintly punctate, rather roughly sculptured, sub-triangular, broader than long, margins of genae nearly straight and slightly raised; clypeus small, sub-quadrate, hairy at the apex, and not projecting beyond margins of genae; eyes crimson, large, prominent; ocelli yellow, equidistant from each other and from eyes; and situated on a level with centres of eyes.

Pronotum bright reddish brown, punctate, with scattered hairs, arcuate, highest above shoulders, laterally compressed, furnished with a strong median carina which is edged with black; metopidium perpendicular; humeral angles rounded, not prominent; posterior process acute, just reaching apex of tegmina.

Tegmina yellowish hyaline; veins brown; clavus and half of the corium covered by the pronotum.

Long. 5.0 mm. Lat. 2.0 mm.

Type: Female. Male with the abdomen pinkish orange; otherwise sexes alike.

A small series taken in the latter part of July and in August on the brown flowering twigs of the *Vismia ferruginea,* where they were attended by ants. This species readily takes wing when disturbed, but soon returns to the foodplant.

Aphetea affinis, sp. nov.

(Pl. III, fig. 4, 4a.)

Head wider than long, coarsely punctate, base slightly sinuate; margins of genae arcuate; clypeus small, blunt, and not projecting beyond genae; eyes brown; ocelli pink, very small and inconspicuous, twice as far from one another as from eyes, and situated on a level with the centres of the eyes.

Pronotum coarsely punctate; metopidium rounded, sloping, twice as wide as high; dorsum slightly sinuate in the middle, somewhat excavated behind the shoulders; humeral angles blunt, not prominent; median carina percurrent, not very marked; posterior process tectiform or boat-shaped, with the apex acute and just reaching the tips of the tegmina.

Tegmina with the costal area very coriaceous, heavily punctate and coloured like the pronotum; remainder of the corium and the clavus, hyaline, with a small black spot at the apex; three parallel basal veins; discoidal cells absent. The first, second, fourth and fifth apical cells are arranged radially round the apex of the third basal area, and the third apical cell is strongly stylate.

Long. 3.0 mm. Lat. 1.5 mm.

Type: Female.

A small inconspicuous species which varies considerably in colour. Eight of the nine females in the series have the head and the pronotum pale grass-green in life, but the colour fades in cabinet specimens. The males and the remaining female are greenish brown, with a few obscure brown blotches on the lateral margins and the apex of the posterior process.

This form was taken early in July on the shoots of a vine in an open place in the forest. The eggs were laid in clusters of twenty to thirty together, in slits in the epidermis of the stems. The females remained seated on the eggs, and they and the nymphs, which ran actively over the plant, were much visited by ants.

Cyphonia clavata (Fabr.).

Cyphonia clavata, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, *p.* 503, 1846.

This species was found from June to September in small numbers on certain favourite shrubs. Both sexes were taken, but I was not able to find the earlier stages, and attempts to induce the adults to oviposit on "sleeved" twigs met with no success. *C. clavata* readily takes wing, but soon returns to the plant. A score or more may be found on the same branch, feeding on the under-sides of the leaves, but they are not gregarious in the sense in which that term has been elsewhere in this paper. Ants abounded on the same foliage, but were never observed to feed from the Membracids. Nevertheless the resemblance between the two forms was very striking in the field, and the mimicry only failed because the Homoptera were sedentary unless disturbed, and did not run restlessly about as the ants did.

* *Cyphonia nasalis* Stal.

Cyphonia nasalis Stal, *K. Sven., Vet-Akad. Handl.*, 3, 6, *p.* 34, 1858.

A female collected at the Station, November 5th, 1920, answers to Stal's description of this species. It has the facies of *C. clavata*, but is larger and has longer and coarser black hairs. The abdomen and legs are pale with black apices; the paired spines at the base of the posterior process are blunt; and below each, on the side of the thorax, is a shining swollen white spot.

Ceresa vitulus (Fabr.).

Ceresa vitulus, Amyot et Serville, *Hist. Nat. Ins. Hemip.*, *p.* 540, 1843.
Ceresa vitulus, var. *minor*, Fowler, *B.C.A.*, *Homop.*, II, *p.* 103, 1909.

Both the type form and the variety were equally common on the coarse herbage in the clearing at the back of the Station.

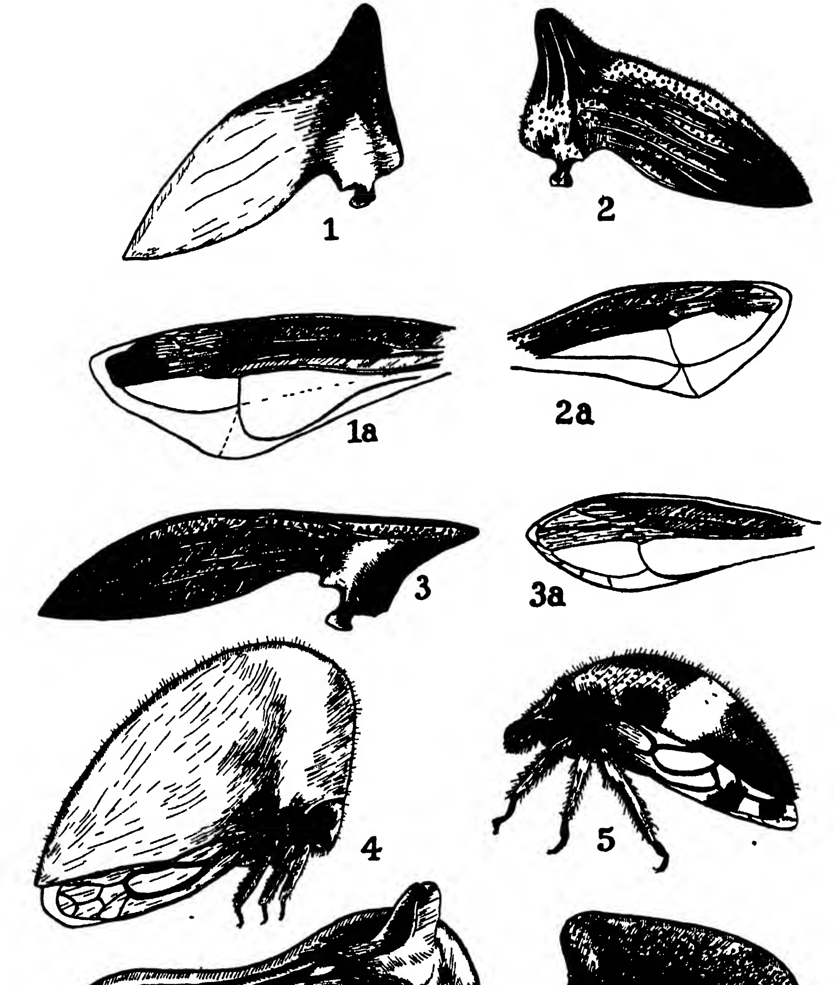


Plate IV —1, *Hille herbicola*, prothorax; 1a, *H. herbicola*, tegmen; 2, *Gelastigonia hirsuta*, prothorax; 2a, *G hirsuta*, tegmen; 3, *Polyglyptodes flavicostatus*, prothorax; 3a, *P. flavicostatus*, tegmen; 4, *Amastris vismiae;* 5, *Boethoos cinctata;* 6, *Centruchoides felinus;* 7 *Stegaspis galeata*, Walk , male

Polyglytodes flavocostatus, sp. nov.

(Pl. IV, fig. 3, 3a.)

Head testaceous brown, punctate, not shining, wider than long, base sinuate; margins of genae nearly straight; clypeus very small, articular margin angular, apex rounded, bristly, scarcely extending beyond margins of genae; eyes brown; ocelli small, yellow, equidistant from each other and from the eyes, and situated on a level with the centres of the eyes.

Prothorax yellowish brown, strongly punctate, furnished with a short, straight horn projecting obliquely forwards and continuous behind with the line of the dorsum, which is non-sinuate and straight from the tip of the frontal horn to the middle of the posterior process, whence it is gradually curved to the apex; basal part of the metopidium carinated, nearly perpendicular and forming an obtuse angle with the frontal horn; humeral angles insignificant; median carina yellow, edged with black, very strong, percurrent; posterior process acute, tectiform, just reaching tip of tegmina, furnished with five yellow costae on either side, extending from the shoulders to the apex.

Tegmina with one discoidal area, the third apical area small; clavus very large; basal and costal regions semi-coriaceous, and punctate, with raised yellow veins.

Underparts and legs brown; tarsi black.

Long. 6.50 mm. (sine cornu. 5.50 mm.). Lat. 2.0 mm.

Type: Female.

A single example was taken August 18th, 1922, on the *Vismia* tree.

Species ?

The determination of the two following species has presented some difficulties According to the keys of Stal, they should be referred to *Oxygonia* Fairm.[1] and *Hille* Stal, respectively, on the strength of the presence or absence of a discoidal cell in the tegmen. But Fowler remarks that this character is not always reliable, and moreover *Hille*, according to Stal, is furnished with longitudinal ridges on the pronotum, which are obscure in my series. A closely allied species in the Hope Museum at Oxford is labelled *Hemitycha* (= *Oxygonia* Fairm.) *erythropus* Burm. Mr. Funkhouser has kindly examined my specimens, and refers them to *Polyglytodes* Fowler, but they are different in facies to the types in the British Museum, and the humeral angles, though not very prominent, are more conspicuous. On the whole it has seemed best to follow Stal's arrangement, though when the long-needed revision of this part of the Smiliinae is undertaken, it may be necessary to remove these forms elsewhere, or perhaps include them both in the same genus.

Hille herbicola, sp. nov.

(Pl. IV, figs. 1, 1a.)

Head pale green, punctate, shining, wider than long, with a dark median line; base slightly sinuate; margins of genae sinuate; clypeus rounded and hairy at the apex, and not projecting for as much as half its length beyond genae; eyes red; ocelli yellow, equidistant from each other and from eyes, and situated on a level with the centres of eyes.

[1] *Oxygonia* = *Gelastigonia* Kinkaldy, *Ent.* 37, 1904.

Pronotum grass-green, coarsely punctate, not pubescent, with a few, slight, irregular, yellowish costae along the lateral margin; metopidium perpendicular, rising into a short, straight, laterally-compressed horn, which is rather variable in height, non-carinate at the sides, and marked broadly with dark brown; median carina sharp, percurrent, edged with black; humeral angles obtusely triangular, not very prominent; dorsum sinuate at base of horn, and gradually sloping to the apex of the posterior process, which is tectiform, acute, and just reaches the tips of the tegmina.

Tegmina with the exposed portion green, coriaceus, and heavily punctate at the base, and infuscate and sub-hyaline at the apex; space divided by the claval suture very large and hyaline; three basal veins; basal areas long and narrow; one discoidal cell; apical areas elongate, the third strongly stylate and very small.

Underparts and legs greenish yellow; femora black.

Long. 6.00 mm. Lat.: 2.50 mm.

Type: Female. Sexes alike.

Social: taken in June on low herbage in a clearing near the Station, and attended by ants. The nymphs are green, elongate, and very effectually concealed in their natural surroundings, as they feed flattened against the stems of the host plant. A specimen labelled *T. notata* Walk. in the British Museum, is evidently very close to this species.

Gelastigonia hirsuta, sp. nov.

(Pl. IV, fig. 2, 2a; Pl. VI, fig. 4.)

Head green, with a black, median line, sub-triangular, rather wider than long; base slightly sinuate; margins of genae nearly straight; clypeus hairy, sub-acute, and not projecting for quite half its length beyond genae; eyes red; ocelli yellow, equidistant from each other and from eyes, and situated on a level with the centres of eyes.

Pronotum grass-green, coarsely punctate, hirsute; metopidium carinate, perpendicular, about as wide as high, continued above into a short, straight, laterally-compressed horn, which is provided with three carinae on either side, and with an irregular, black stripe which is continued downwards over the shoulders; humeral angles sub-triangular, not very prominent; dorsum strongly carinate, scarcely at all sinuate at base of horn; posterior process tectiform, acute, just reaching apex of tegmina, and furnished on each side with five or six longitudinal costae.

Tegmina with the exposed portion green, punctate, and coriaceous, infuscate towards the apex and along the third basal area; venation as in the last species, but destitute of a discoidal cell.

Underparts and legs greenish yellow.

Long. 6.00 mm. Lat. 2.75 mm.

Type: Male.

Two examples taken June 16th, 1922, in a colony of *Hille herbicola*, which species they closely resemble.

***Telemona spiniger**, sp. nov.

(Pl. III, fig. 3.)

Head wider than long, roughly sculptured, polished, shining; margins of genae sinuate; reflexed; clypeus very small, laterally bi-lobed and rounded at the apex, not projecting beyond margins of genae; base of head somewhat sinuate; eyes pale grey, prominent; ocelli translucent, equidistant from each other and from eyes, and situated on a level with the centres of the eyes.

Pronotum rough, coarsely punctured, shining, not pubescent, much compressed behind shoulders; metopidium twice as high as wide, inclined backwards, slightly sinuate when seen from the side, carinate; humeral angles triangular, strongly produced; dorsum furnished with a high blunt prominence above the shoulders; median carina percurrent and strongly compressed; posterior process very acuminate, lateral margins arcuate when seen from the side, just reaching apex of tegmina.

Tegmina entirely free, yellow, hyaline, punctured at the base, and with a small black spot at the apex of the clavus; veins brown.

Femora somewhat swollen; tibiae spined.

Long. 11.0 mm. Lat. (int. hum.): 6.0 mm. Alt: 6.0 mm.

Type: Female.

Described from a female collected at the Station, June 24th, 1922. The colours are evidently faded. The head and pronotum are yellow (? green in life) thickly mottled and punctured, especially along the dorsum, with ferruginous (? red) and the underparts and legs are yellow (? green). This form differs from other species of the genus with which I am acquainted in the shape of the metopidium and posterior process.

Bocydium globulare (Fabr.).

Bocydium globulare, Fairmaire, *Ann. Soc. Ent. Fr.*, 2, IV, p. 508, 1846.

This remarkable Membracid was taken by sweeping in June and again more abundantly in September. The nymphs were not found; and all the examples of both sexes that were obtained were feeding singly on the undersides of green leaves where they were comparatively conspicuous objects. They took wing readily when disturbed, and apparently were never attended by ants, although the latter were common on the foliage around them.

Centruchoides felinus, sp. nov.

(Pl. IV, fig. 6.)

Head ferruginous, with thick yellow pubescence, wider than long, base arcuate and emarginate; margins of genae prominent, sinuate, deeply notched at the apex; clypeus small, depressed, trilobed, with the lateral lobes small and angular and the median lobe larger and rounded, not projecting much beyond genae; eyes brown, prominent; ocelli grey, equidistant from each other and from eyes.

Pronotum ferruginous, punctate, thickly pubescent, furnished above the shoulders with two, stout, pointed horns; metopidium perpendicular, carinate; horns strongly tri-carinate, flattened above, their breadth at base almost equal

to their length; a well-marked percurrent carina arises between the horns and extends to the apex of the posterior process.

Posterior process very acuminate, slightly longer than the abdomen and triangular in section; seen from above, it is narrow at base, slightly expanded behind the scutellum and tapers gradually to the apex; seen from the side, it is sinuate, sloping abruptly to the scutellum, and is then slightly raised again and depressed towards the apex.

Scutellum dark brown, with white tomentose patches, about as wide as long, truncate behind, with a pale denticle lying on either side of the posterior process.

Tegmina ferruginous, semi-opaque, not quite half as long again as abdomen, with numerous, brown, scale-like patches; veins brown, base and costal margin heavily punctate; one discoidal and five apical areas. Wings hyaline grey, with four apical cells. Abdomen rufous brown; ovipositor long and stout; underparts and femora sooty brown to black, with white tomentose patches; tibiae ferruginous, flattened and dilate; tarsi sooty.

Long. 8.0 mm. Lat. (int. corn.): 3.0 mm.

Type: Female.

Sexes alike, except that the abdomen of the male is short and crimson in colour.

Four females and a male taken in August on the branches of a small tree with reddish bark, common in the clearings. The venation of this form differs somewhat from that of Fowler's type species (*C. laticornis*).

Lycoderes hippocampus (Fabr.).

Lycoderes hippocampus, Stal. *K. Sven, Vet-Akad. Handl.*, 8, *p.* 52, 1869.

A solitary and rather scarce species, taken occasionally in August and September. The early stages were not found. The insect fed in the axils of the leaves of low shrubs in shady places. The pale green body, seen through the transparent part of the tegmina, and enclosed by the dark apical areas behind and by the pronotum above, gives the whole insect a remarkable resemblance to a partly withered leaf stipule. This form, according to my observations, is not visited by ants.

Stegaspis laevipennis (Fairm.).

Stegaspis laevipennis, Walker, *List Homopt. Ins. Brit. Mus.*, *p.* 635, 1850.

Two females taken September 9th, 1922, on a red-barked shrub in a clearing. The insects fed in the axils of the leaves, and bore an unmistakable resemblance to stipules.

Stegaspis galeata Walker.

Enchenopa galeata Walker, *List Homopt. Ins. Brit. Mus.*, *p.* 486, 1850.
Stegaspis galeata Walker, *Ibid, Supp.*, *p.* 341, 1858.
Hypsoprora insignis Buckton, *Mon. Mem.*, 1909.
Stegaspis insignis, Funkhouser, *Journ. N. Y. Ent. Soc.*, XXX, *no.* 1, *p.* 34, 1922.

(Pl. IV, fig. 7; Pl. V, fig. 5.)

A gregarious form, attractive to ants, and not uncommon on green vines and juicy shoots in shady places from June to September. The colour of my

series varies from ochreous brown to rusty black, and the sexes are dimorphic, for the male lacks the frontal horn.

The above synonomy is suggested after examination of Walker's specimens in the British Museum, which are identical with the examples from Kartabo. Mr. Funkhouser has suggested to me that *S. folium* Oliv. may be a synonym. Stal (K. Sven. Vet-Akad Handl., 8, p. 54, 1869) supposes *S. folium* to be identical with *S. melanopetala* Oliv. Stal's description is of the male sex, and Stoll's figure 80, and possibly 48 also, probably represents this unhorned form. Stoll's figure 31, according to Stal, is of *S. fronditia* Fabr., and this is evidently near to, if not identical with, the female of the species under discussion. Until the types of the older writers can be re-examined, Walker's name has priority over that of Buckton.

Ischnocentrus niger Stal.

Ischnocentrus niger Stal, *Ofv. K. Vet-Akad. Forh.*, p. 293, 1869.

A male and female taken at the beginning of August, feeding singly on the bark of twigs in a shady place. Their appearance was very ant-like, and some of the ants, which were numerous on the foliage, were gathered round them.

Fowler (*B.C.A.*, *Homop.*, II, *p.* 155) regards Stal's species, *I. niger* and *I. ferruginosus*, as the sexes of the same form. This conclusion is borne out by my two examples, of which the male is black and the female is rich brown. The only structural difference between them is that the posterior process of the male is slightly reflexed, while that of the female is straight.

Tolania scutata Stal.

Tolania scutata Stal, *K. Vet-Akad, Handl.*, 3, 6, *p.* 37, 1858.

A female, taken September 5th, 1922, on the bark of a shrub at the edge of a clearing. Stal's type was a male, but I have little doubt from his description that this belongs to the same species.

Tropidaspis carinata (Fabr.)

Tropidaspis carinatus, Stal, *K. Sven. Vet-Akad. Handl.*, 8, *p.* 56, 1869.

(Pl. V, fig. 4.)

This form was fairly common in shady places on the bark of twigs, and was invariably attended by ants. It was, moreover, the only species over which the ants showed any solicitude when disturbed. Twice I found a small colony with their eggs completely enclosed with some Coccids under an earth-crust. When the latter was broken into, some of the nymphs were seized by the ants and carried for a short distance, but they were soon abandoned. At other times, *T. carinata* fed in the open; and although the ants visited the colonies, they did not display unusual perturbation when the Membracids were interfered with. In the males of my series, the tegmina are more opaque and the general colour is darker than in the females. The pale fascia across the scutellum is sometimes almost absent in both sexes.

Tropidaspis minor, sp. nov.

(Plate V, fig. 3.)

Head deflexed, longer than wide, punctate; ocelli situated close to upper margins of eyes.

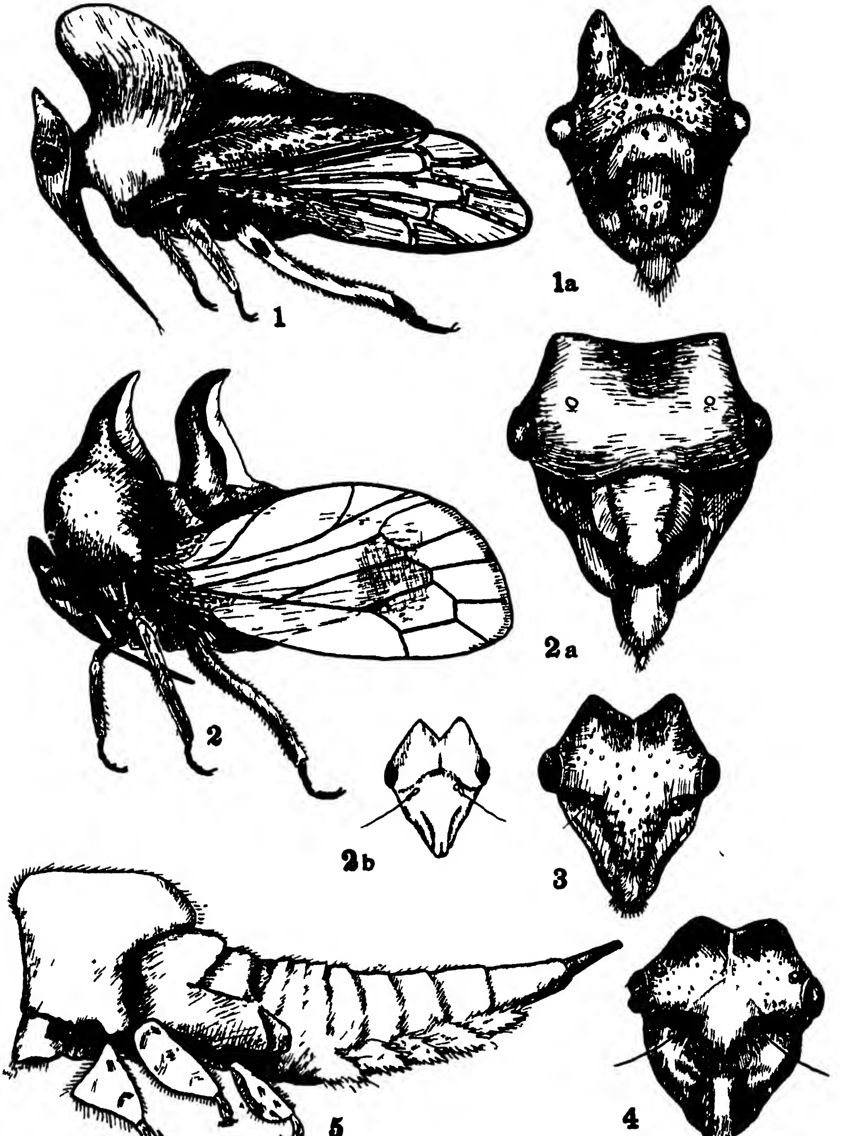


Plate V.—1, *Tropidaspis cornuta;* 1a, *T cornuta*, frontal view of head, 2, *Lophyraspis armata;* 2a, *L armata*, frontal view of head; 2b, *L armata*, head of nymph of the third instar, 3, *Tropidaspis minor*, frontal view of head, 4, *T carinata*, Fabr , 5, *Stegaspis galeata*, Walk., nymph of the fifth instar

Pronotum with the humeral angles blunt and little produced; somewhat excavated behind the shoulders; posterior margin gently sinuate, and furnished with a slight median carina. Scutellum as long as the abdomen, acuminate, and with a sharp percurrent carina extending to the apex.

Head, prothorax and scutellum pale testaceous, densely punctured and variegated with black and chestnut brown.

Tegmina hyaline, coriaceous, and punctate at the base; veins raised and broad, spotted with brown and white.

Legs and tarsi sordid ochre; the hind tibias curved and furnished with three rows of spines.

Long. 3.50 mm. Lat. 1.50 mm.

Type: Female.

Resembles the last species, but is smaller and paler in colour, and the base of the head is more acutely lobed.

Two females were taken at the end of July on their flat oval egg-cases on the bark of a shrub in the jungle, attended by ants.

Tropidaspis cornuta, sp. nov.

(Plate V, figs. 1, 1a.)

Greenish yellow, heavily mottled and punctate with black and brown. Head sub-triangular, much longer than wide, base produced into two conical lobes above the eyes; margins of genae somewhat arcuate; clypeus very small and scarcely projecting beyond genae; eyes brown; ocelli yellow, situated at the base of the lobes, close to, but above, the inner margins of eyes.

Pronotum hexagonal, with the anterior margin rounded and raised, posterior margin straight, and somewhat impressed in front of shoulders; furnished with a strong keel, which is produced above the shoulders to form a high, laterally-compressed, rounded crest, projecting forwards.

Scutellum not quite as long as the abdomen, very narrow, acuminate, with a sharp percurrent keel, which, seen from the side, is somewhat sinuate, and laterally-compressed behind the middle.

Tegmina semi-opaque, coriaceous, punctate at base and along the costal and claval margins; veins broad, raised, and decorated with lighter spots. Under parts pitchy brown; tibiae and tarsi yellow, spotted with black; hind tibiae curved and furnished with three rows of small, black spines.

Long. 3.50 mm. Lat. 1.50 mm.

Type: Female. Male slightly smaller and paler.

The absence of discoidal cells, the position of the ocelli and the unarmed scutellum justify the inclusion of this form in *Tropidaspis*. The lobes of the base of the head are much more pronounced than in the type species, but *T. minor* is transitional in this respect.

T. cornuta is a small brown rough-looking insect. Two examples were taken in August on the petiole of a shrub in dank jungle. The female was sitting on a flat condate egg-case, attended by ants.

Lophyraspis fowleri, nov. nom.

Gerridius scutellatus Fowler, *B C A*, *Homop.*, II, *p* 166, 1909. (*nec Lophyraspis scutellatus* Stal)

After a careful comparison of the characters determining the genera

Lophyraspis Stal and *Gerridius* Fowler, I have come to the conclusion that the distinctions between them are not well defined, and that therefore Fowler's genus, erected in 1909, cannot stand. Mr. Funkhouser writes to me that he is also of this opinion. The name *scutellus* being preoccupied in *Lophyraspis*, it is necessary to re-name Fowler's type species, and I suggest that it be known henceforward by the specific designation *fowleri*.

L. fowleri was found in July, in a shady clearing, on the shoots of a shrubby plant infested with *L. armata*. It was gregarious and was attended by ants. The Membracid itself has a peculiarly ant-like appearance when feeding, owing to its habit of raising its long, curved, hind tibiae and gently waving them to and fro in the same manner as its congener *L. armata* and many Aphididae.

The determination of the two following species has presented some difficulties, as I have not seen Stal's types.

The structure of the head closely resembles that of *Ischnocentrus* and *Tropidaspis*. Stal separated *Lophyraspis* and *Lamproptera* on the form of the base of the head, and the number of discoidal cells. Fairmaire remarks of *Lamproptera*, "elytres tout a fait semblables a celles des Lycoderes pour les cellules," and figures *L. vacca* with one discoidal cell as in *Lycoderas*. The only example of the genus to which I have had access is the single specimen of *Lamproptera stylata* Buckt., in the Hope Museum, and there the venation is identical with that of *Lophyraspis; Tropidaspis*, according to Stal, had no discoidal cell, and yet the venation is unmistakably of the same type. The discrepancy is due to the use of the term discoidal. In Lophyraspis the external, and only true, discoidal cell, is formed by the forking of the radial vein. The internal cell is really the radial-medial basal area, for the radial and medial veins are conjoint for some distance from the base of the tegmen. The same thing occurs in *Lamproptera stylata*. In *Tropidaspis*, all three main veins are distinct at the base, and the radial areolet is so elongated that its discoidal nature is masked. Fowler remarks that in his types of *Tropidaspis affinis*, there are two discoidals on one side and one on the other; this is probably due to the shifting of the bifurcation of the radial vein.

Lophyraspis armata, sp. nov.

(Plate I, fig. 10; Plate V, figs. 2, 2a, 2b.)

Head bronze-black, punctate, triangular, rather longer than wide, base raised into a high, slightly sinuate crest, which is obtusely angulate laterally, and bi-cornulate only in the nymph; lower margins of the vertex produced above a deep sulcus in which the antennae are inserted; margins of genae sinuate; clypeus trilobed, not projecting beyond genae; ocelli equidistant between eyes and median line, and situated on a level with the upper margins of eyes, vertex between them strongly impressed.

Pronotum bronze-black, punctate, strongly convex; humeral angles obtuse and slightly prominent; median carina slight in front and rising behind into a high, backwardly projecting pointed crest, with the anter or edge ferruginous, blunt, and the posterior sharp and knife-like, with a black fascia bordered behind with white; posterior margin arcuate.

Scutellum ferruginous, shining, acuminate, scarcely longer than wide, marked laterally with white tomentose patches; median carina developed into a crest as high as that of the pronotum, rounded in front, recurved behind and bordered with black and white fascia; apex white. Tegmina hyaline, shining, polished, coriaceous and punctured at base, with a median cloudy brown spot; veins and margin brown. Underparts and femora sordid yellow; tibiae and tarsi black; hind tibiae long, curved, hairy, furnished with numerous small spines; hind tarsi very long.

Long. (front of head to apex of tegmen): 4.00 mm. Lat. 1.20 mm.

Type: Female.

Male similar, but with dorsal crests less developed.

These Membracids were taken several times between June and August on twigs in shady places. They are social, and remain upon, or near, their egg-cases, where they are much visited by ants. They and the dull green nymphs are active and move about freely. When feeding, the adults have a curious habit of waving their long hind tibiae in the air as Aphides are accustomed to do. This gives them a remarkably ant-like appearance in the field; and when ants are present in numbers it is difficult to distinguish one from the other.

Stal (*K. Sven. Vet-Akad. Hand.*, 1869, *p.* 56) in a footnote describes *L. cristata*, in which the pronotum and scutellum are both furnished with high crests. The description is inadequate for accurate determination, but it is quite possible that *L. cristata* is identical with the form described here.

Lophyraspis pygmaea (Fabr.).

Lophyraspis pygmaea, Stal, *K Sven Vet-Akad Handl*, 8, 1, *p.* 55, 1869

This form resembles the last but is smaller. The pronotum is bronze-black and punctate, convex and rounded behind, with a very slight median keel. The base of the head and scutellum are bright brown, and the underparts and legs are sordid yellow.

The scutellum is triangular, rather longer than wide, transversely convex, with a black median keel more developed behind, where it dips abruptly to the apex which is white and very acute.

Tegmina as in the last; but with the apical margin more broadly infuscate. The hind tibiae are long and curved, and furnished with short close spines.

Endoiastus productus Osborn.

Endoiastus productus Osborn, *Zoologica*, *Vol* III, *no.* 10, *p.* 233, 1921.

(Plate I, fig. 8, eggs.)

The genus *Endoiastus* was erected by Fowler for the reception of *E. caviceps; E. productus*, which differs from the type species in its dark colour, more slender form and narrower head, was described by Osborn from material collected by Dr. Wheeler from *Tachigalia* at Kartabo in 1920.

In 1922, I found this Membracid only in one spot, where, however, it bred in numbers from June to September. The eggs were laid in slits in the epidermis of the stems, petioles, and on the undersides of the leaves of the *Tachigalia.* About thirty were deposited together, usually in a double, but sometimes in a single, row, and the adults and nymphs clustered together in crowds under the foliage. The nymphs were active, dark green and not mealy, but the adults were sluggish and seldom moved unless touched.

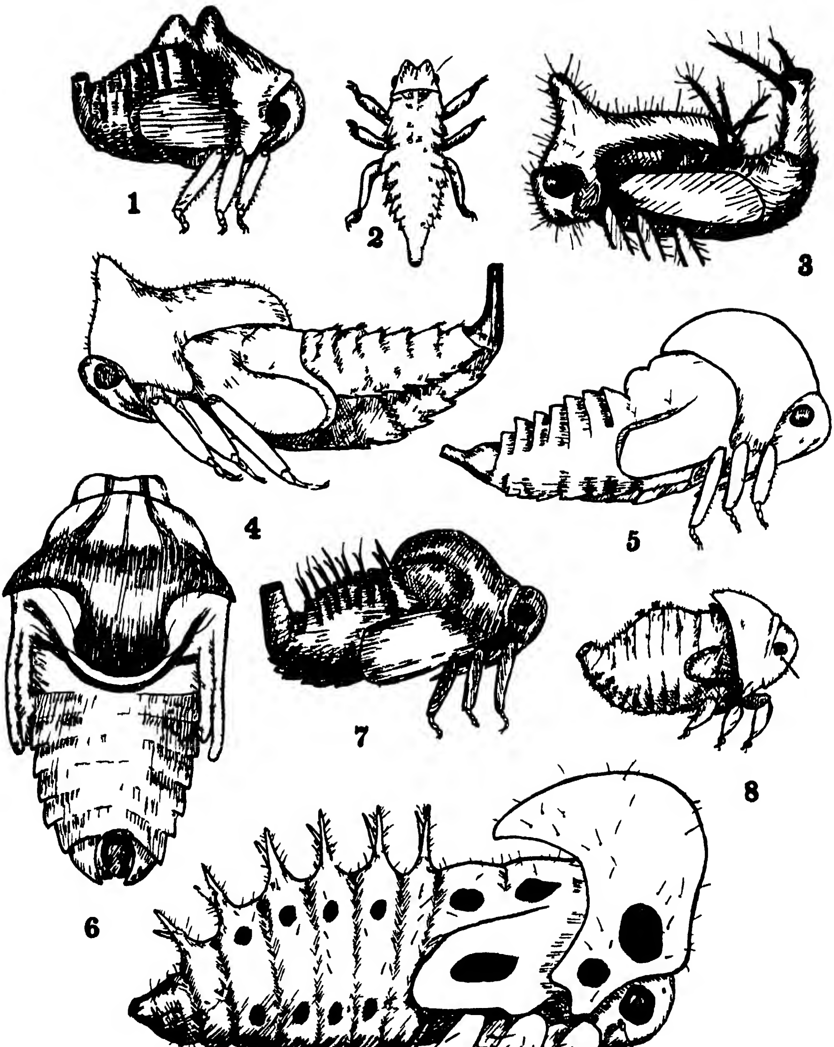


Plate VI —Nymphs of, 1, *Bolbonota aspidistrae* fifth instar 2 *Enchenopa bifenestrata*, Funkh , second instar 3, *Campylenchia nutans*, Germ , fifth instar 4 *Gelastigonia hirsuta*, fifth instar, 5, *Amastris elevata*, fifth instar 6 *Tragopa cimicoides* Fabr fifth instar 7, *Boethoos reticulata*, Fabr , fifth instar 8, *Tropidocyta bulbosa* fifth instar 9 *Membracis c-album*, Fairm , fifth instar

Dr. Wheeler (*op. cit., no.* 4) has given an account of the relations of the host plant to the ant which live in the hollow petioles of the leaves and feed on the excreta of the Membracids.

Aethalion reticulatum (Linn.), var. *albo-nervosum.*

Aethalion reticulatum, Germar, *Mag. der Ent*, IV, *p.* 95, 1835
Aethalion reticulatum, var. *albonervosum* Fowler, *B.C.A*, *p.* 171, 1909.

(Plate I, fig. 11, eggs.)

Taken in some numbers in August on the branches of a tree within fifty yards of the Station landing-stage. This species is gregarious and the females, which are sluggish and reluctant to take wing, can be picked off the eggs with the fingers. The egg-cases, though large, are of the usual Membracid type, with the eggs embedded in pale brown elliptical masses of wax. The colony was much visited by ants.

This form possesses scarcely a single distinctive Membracid character. But the head of the nymph, apparently less modified than that of the adult, shows affinities with certain Centrotinae; and therefore it has seemed best here to follow Fowler's arrangement, and include this anomalous genus in the Membracidae.

Geographical Distribution.

The Membracid fauna of the Kartabo forest is intermediate between that of the Panama region and the Amazon basin. Thus of forty species whose distribution is given by previous writers, twelve are peculiar to Guiana and Brazil, and ten to Guiana and the Central American area. As sixteen are common to all three regions, it is evident that many neotropical Membracidae have an extensive range; and as further data are obtained, we shall probably find that numerous forms have a wider distribution than appears at present. This is already clear if we take the genera rather than the species, for almost every genus of the Kartabo collection is widely distributed between Lat. 20° N. and Lat. 25° S.

At the same time, the extensive range of many forms is rather remarkable, for, as I have pointed out elsewhere, the primaeval forest which occupies so much of the South American Continent is not the most favoured environment for most Membracidae. Thus of sixty-nine species at Kartabo, forty-two were taken in and around clearings, and only thirteen inhabited the deeper forest. Fourteen were intermediate in their haunts, but even this group was confined to the lighter trails and glades where the shade was not too dense. Of course even the clearing dwellers are shaded by vegetation. The only form which seems able to bear the full glare of the sun is *Enchenopa lanceolata*, which inhabits low plants on the open river

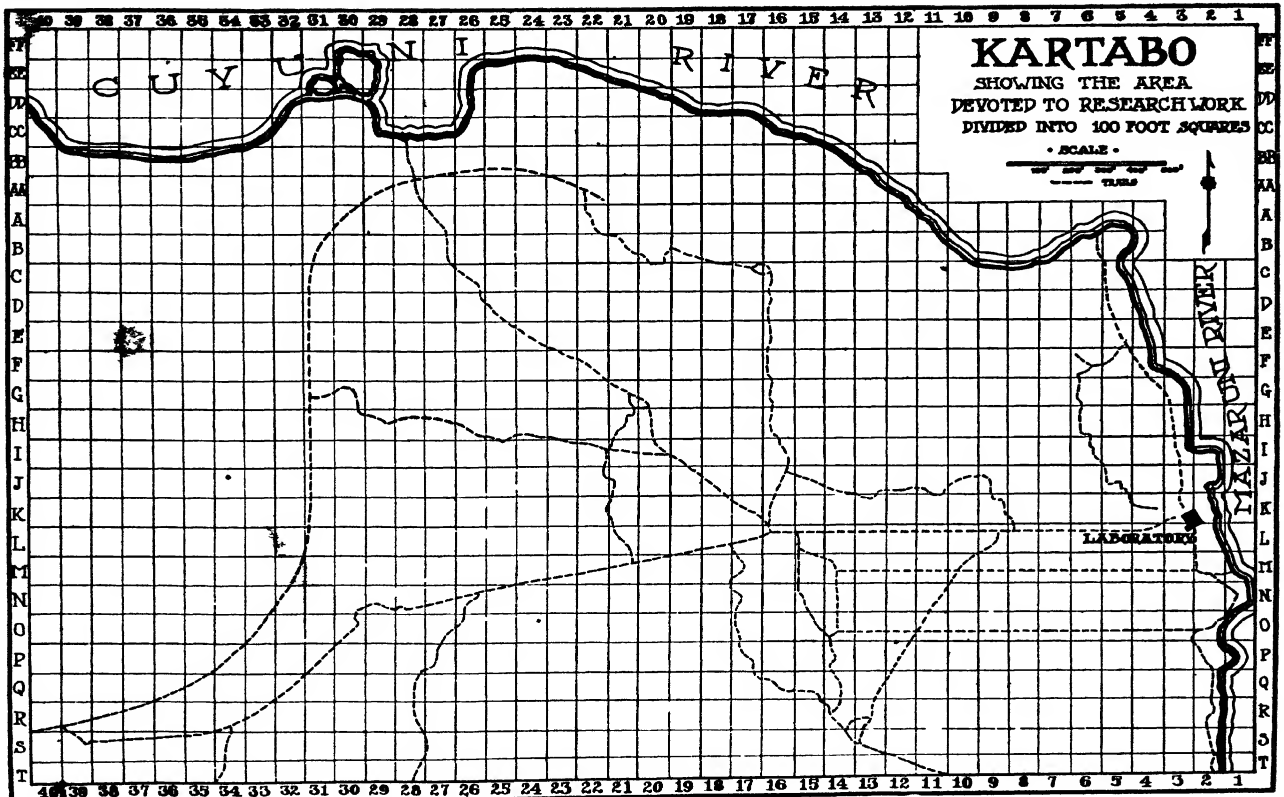


Plate B Area devoted to research at Kartabo.
Drawing by John Tee-Van

bank, and is exposed from sunrise to sunset. But the darker, damper parts of the forest are poor in Membracidae, and as the greater part of equatorial South America is clothed with this deep forest, the wide dispersal of the light-loving forms is curious. Unless they can sustain themselves among the tree-tops, a point on which at present we have no information, they must have followed the lines of more open forest, and clearings in virgin jungle are relatively scarce and restricted in extent. We are perhaps too apt to regard the tropical forest zone as a homogeneous area, and overlook that within its bounds conditions vary greatly, so that, to many species, migration is only possible along certain definite tracks or routes.

LIFE-HISTORIES AND HABITS.

The Membracidae of Kartabo are divided rather sharply into two natural groups, the forest forms and the clearing forms. The first group is much the smaller, and except for *Darnis partita* and *D. latior*, includes chiefly such insonspicuous species as *Tropidocyta gibbosa, Tropidaspis carinata, Endoiastus productus* and the *Bolbonotas*. Even of these, many haunted places where the shade was not too dense; and the dark swampy forest along the river banks was almost destitute of Membracidae. On the other hand, the secondary growth round the Station, and in the abandoned cassava clearings further afield, was rich both in individuals and in species. This was partly owing to the change in flora induced by felling of the forest, and partly because Membracidae are light-loving insects. This is not to imply that they seek the full sunshine,—the only species that seemed able to tolerate the open ground was *Enchenopa lanceolata,*—but most other forms sought bright diffused light under foliage round the clearings.

Professor Poulton (*Buckton, Mon. Mem.*, p. 9) quotes Mr. Nelson Annandale's observations in Malacca, where "insect-eating animals retire to rest during the hottest hours of the day, and at this very time, insects, including such cryptic forms as the stick-like Phasmids, move about freely, assume forms, and occupy environments in which they are quite conspicuous." Funkhouser (*Mem. Cornell Univ. Agric. Exp. Stat.*, p. 392, 1917) observed that the Membracidae of the Cayuga Lake Basin were most active during the hottest parts of the day. Possibly the Kartabo Membracidae were on the whole more active in the morning, and the usual time for the emergence of

the adults was in the forenoon; but this is only a general impression, and the eggs seemed to hatch at all hours. I have captured *Tragopa cimicoides* and *Ceresa vitulus* on the exposed tops of herbage in clearings between three and four o'clock in the afternoon; but most of the insects appeared to take cover under the leaves when the sun was high. Nearly all the species recorded are rather sedentary, and occupy positions where they are permanently shielded from the direct rays of the sun.

The marked division of the Kartabo Membracid fauna into forest and clearing forms opens the question whether many of the latter have extended their range of late years, in correlation with the extension of settlements and cultivated ground. From examination of collections in the Georgetown and New York Museums, it appears that the species from Kartabo, when represented, are generally distributed along the coast and up the rivers as far inland at any rate as Kaieteur, and probably have a foot-hold everywhere where the forest is scanty enough to afford the optimum of light and shade. Many places up the rivers have been cleared and settled for the last two hundred years, and the immigration of light-loving forms is not necessarily recent.

Without special botanical knowledge, it has not been possible to give a list of hosts, but my notes indicate that many forms are monophagous, or at least restricted to a few species of plants. Probably this is the reason why many species are gregarious and form colonies, not only with their own kind, but with other genera. Some of these are recorded below:

Tragopa cimicoides
Enchenopa bifenestrata
Tragopa partita

Tragopa cimicoides
Horiola arcuata
Boethoos distinguenda

Membracis c-album
Membracis fusca
Boethoos reticulata
Enchenopa monoceros

Horiola arcuata	
Boethoos globosa	*Vismia ferruginea*
Horiola ferruginea	

Vanduzea testudinea	
Tragopa guianae	*Vismia ferruginea*
Tragopa tripartita	

In passing, one might perhaps comment on the superficial resemblance of some of these gregarious forms. Such, for instance, are *Tragopa guianae* and *Vanduzea testudinea, Horiola arcuata* and *H. ferruginea* and *Boethoos globosa.*

The Membracidae often occur in such numbers on an individual host that it is rather remarkable that the plants attacked are seldom distorted or galled. The only species at Kartabo which regularly gives rise to a specific deformity is *Tropidocyta gibbosa.* Here the inflorescence of a certain shrub is attacked when in bud. The stem becomes nodose and woody, and the buds abort and fall off. The reason for the apparent immunity of most hosts is that the Membracids infest only the stem, and do not touch the shoots or leaves until the latter are fully formed.

The egg-masses of Membracidae are usually distinctive objects, and those of which I have records can be referred to two principal types. In one the eggs are deposited in a mass of waxy colleterial fluid, which soon hardens on exposure to the air, and the epidermis of the plant is little, if at all, lacerated. In the other, there is very little fluid, and the eggs are deposited in incisions in the plant's tissues. With certain exceptions, the first is the general type of the Membracinae and Centrotinae; the second is that of the other subfamilies. The form and colour of egg-cases of the first type have already been dealt with in the list of species at the commencement of this paper, and vary considerably in different genera.

Some older writers have credited the Membracidae with parental care for their eggs, on the ground that some forms remain seated on the mass for some time after oviposition is complete. The idea probably arose because the process is often a somewhat lengthy one, and the mother sits quietly sucking for hours or even days while the mass beneath her grows larger. But I am not quite sure that the idea is as far-fetched as some other writers have supposed. There is no need to credit the female Membracid with conscious instincts of maternity; but the fact that she remains on her nursery may serve to protect it, either by keeping away certain enemies, or, conceivably, by regulating the temperature or moisture.

Early in July I had colony of *Bolbonota aspidistrae* under daily observation, and the following are extracts from my diary:

July 4th: Six nests and some late nymphs beside the Puruni Trail. Females in five of the nests.

July 5th: Two more nests with females on the same plant. Took three females away from nests.

July 7th: Three out of four remaining females still on eggs. One unoccupied nest hatching.

July 8th: More nymphs hatching from one occupied and one empty nest. Ants round all nests. Two deserted nests look crumbling.

July 10th: Nymphs still emerging. Two empty nests rather shrivelled and discoloured; a third half broken away.

July 12th: All females gone and the two latest nests beginning to hatch out. The nest originally unoccupied and two whose females were removed do not seem to have produced nymphs, for the eggs are shrivelled.

Observation on three more marked nests of the same species later on showed that nymphs would appear when the female was removed; but out of fifteen or so eggs in each mass, only half a dozen nymphs emerged, and examination showed that the remaining eggs were flaccid, shrivelled and apparently broken.

On the other hand, some experiments with *Enchenopa bifenestrata* gave negative results, and the proportion of hatching eggs seemed unaffected by the removal of the female.

The duration of embryonic life is not easy to determine since the eggs are not all laid at once and therefore hatch at irregular intervals. Observations on certain species gave the following approximate results:

Enchenopa bifenestrata	8 days
Enchenopa lanceolata	6 days
Tragopa partita	?5 days
Bolbonota aspidistrae	6 days
Campylenchia nutans	7 days

The nymphal period was longer than I expected to find it in the tropics where all life seems keyed to such a high and exuberant pitch. The following list is compiled from certain species whose nests were isolated and kept under daily observation:

Instars	1st	2nd	3rd	4th	5th
Bolbonota aspidistrae	2 days	5 days	4 days	6 days	7 days
Lophyraspis armata	——	——	?4 days	6 days	8 days
Aconophora compressa	3 days	5 days	?4 days	6 days	9 days
Enchenopa bifenestrata	——	3 days	3 days	5 days	9 days

I have also kept colonies of fifth instar nymphs of *M. tectigera* and *Enchenopa nutans* under observation for eight days and ten days respectively.

The nymphs of most of the species described in this paper are often quite active, and seek to escape by dodging round the stem of the plant, but in no case were they ever seen to hop. The adults are frequently disinclined to move, but when they make up their minds to leave the plant, they spring away like lightning. It is easy to see a Membracid arrive. It is still more easy to see a valuable specimen depart; but in the intermediate stages of its transit it is usually invisible. Many forms have a remarkable homing faculty; and within half an hour of their departure, they may be found feeding again on the very branch from which they previously fled headlong.

Attendance by Ants.

It has long been known that certain species of Membracidae are visited by ants for the sake of their excretion, the so-called "honey-dew." Belt (*Naturalist in Nicaragua*, p. 227, 1874), Rice (*Insect Life*, p. 243, 1893), Baer (*Bull. Soc. Ent. Fr.*, p. 306, 1903), Branch (*Kansas Univ. Sci. Bull.*, VIII, 1913), Lamborne (*Trans. Ent. Soc.*, January, 1914), Funkhouser (*Mem. Cornell Univ. Agric. Station*, II, 1917), and others, have published observations on this point.

In all the known cases, the association seems to be a sort of loose commensalism, and not the close interdependence that is found between ants and some other insects. Rice states that the nymphs of *Entylia sinuata* reached the adult state in two weeks if ants were present and in one if they were absent; but the statement is rather general, and possibly experiments with different controls might have given other results. Branch considered that ecdysis was irregular in the absence of ants; but as the experiments were conducted in the laboratory, it is more probable that malnutrition was responsible. Funkhouser, who investigated this problem, found

that the presence or absence of ants had no effect on development. I endeavoured to work out this point, but the attempts were not wholly successful, owing to the difficulty of isolating the colonies of Membracids on their natural food-plant under conditions where ants were numerous and heavy rain-storms frequent. As far as they go, my results confirm those of Funkhouser.

Most of the records suggest that the ants feed only from the anal tube. This is not altogether correct, for although the visitors have learned that stimulation of the Membracid secures the extrusion of a drop of excreta, yet they readily take what had already fallen. This gives the key to the origin of the association. Ants of various species swarm over the foliage in the forest whether Membracids are present or not. They visit the nectaries on the leaves of plants, bird-droppings, excreta of other insects, such as Coccids, etc. Hence a colony of Membracidae is a god-send and a crowd quickly gathers round it. In fact, so numerous and so ubiquitous are foraging ants, that where a few examples only of a species of Membracid are taken, it is not always easy to say whether it is regularly visited or not, and it is no wonder that most gregarious Membracidae are thus attended.

The list of unattended forms given elsewhere in this paper shows that they all are solitary when adult.[3] In fact habit rather than physiology seems to determine whether ants shall or shall not visit them. Thus *Stegaspis laevipennis* and *Lycoderes hippocampus* were not attended; *Stegaspis galeata*, which occurs in colonies, was visited freely. Howver, Funkhouser (*op. cit.*, p. 399) brings evidence to suggest that social habits are not the only factor concerned. The host plant often plays a considerable part. *Endoiastus productus* feeds on *Tachigalia* shoots, and the hollow petioles are occupied by ants (Wheeler, *Zoologica*, 1921), which naturally resort to the manna that the Membracids strew at their doors.

According to my observations at Kartabo, when an ant-attended colony is disturbed, the ants attack the invader savagely, but pay no attention to the Membracids. The only exception to this was in a colony of *Tropidaspis carinata*, which had been completely covered up with vegetable fibre. When the roof was broken in, half a dozen ants each seized a nymph, but after carrying them aimlessly for a short distance, they dropped them without further interest. *T. carinata*, *Horiola arcuata*, and *Boethoos reticulata* were the

[3] The early stages are not known.

only forms that I found completely enclosed in ants' nests on twigs. Here at least I expected to find evidence of more interdependence; but after some study I came to the conclusion that the association was fortuitous, for all three species flourished equally well when unenclosed. The covered twig was always infested with Coccids, and probably these, rather than the Membracids, were objects of care. The Membracids seem indifferent whether the ants cover them up or not. When the shelters are broken, the adults jump away and the exposed nymphs, as I have frequently observed, continue to feed, sometimes for days afterwards, on the exposed bark, although movement a few centimetres to right or left would bring them under cover again.

I must express my thanks to Dr. W. M. Wheeler, who has been good enough to determine the following species of ants for me:

Camponotus femoratus Fabr.; taken in attendance on *Tragopa cimicoides, Endoiastus productis, Lophyraspis armata, Horiola arcuata.*

Crematogaster (*Orthocrema*) *limata* Smith; var. taken in attendance on *Horiola arcuata.*

Azteca paraensis Ferel; taken in attendance on *Campylenchia nutans.*

Pheidole sp.; taken in attendance on *Amastris elevata.*

Pheidole fallax Mayr.; taken in attendance on *Boethoos testudinea.*

ENEMIES.

Our present knowledge of the enemies of Membracidae is very inadequate, and I regret that I am able to add little or nothing to it.

Aconophoroides gladiator and *Cymbomorpha vaginata* were occasionally found to be captured by hunting spiders, and *Membracis tectigera* was taken from a web. Internal parasites in the nymphs were not observed. Possibly the constant visits of ants tend to prevent this kind of attack. Nevertheless a Myrmarid, of species as yet undetermined, was seen to parasitize the eggs of *Tragopa cimicoides, Aphetae affinis,* and *Campylenchia nutans.* The Myrmarid, which was slow and furtive in its movements, like many of its family, crawled leisurely over the eggs, ovipositing in each, in some cases while the Membracid female was still sitting on the mass, and before laying was finished. Ants were running around,

and even over the Membracid, but the parasite completely disregarded them and crept under the mother's wings to accomplish its task.

Field Observations on Form and Colour.

Buckton's *Monograph of the Membracidae* includes an interesting and suggestive essay by Professor Poulton, on the "Meaning of the Shapes and Colours of the Membracidae." In the writer's own words, his remarks are merely suggestions, and are in no sense dogmatic utterances. "I feel," he says, "that in this most remarkable group of insects, the examination of figures, or even of the specimens themselves in a museum, can only occasionally afford us the foundation for a valuable opinion as to the bionomic meaning of the forms and patterns. But such an examination continually suggests possible interpretations which may lead the observer of the living species to think, and may sometimes even direct him into the right track."

It has been of interest to compare my notes taken in the field with the interpretations that study of similar forms in the cabinet suggested to such an authority as Professor Poulton; and possibly a discussion of observations made independently from the two points of view may not be out of place here. It may well prove that my own conclusions will not hold good for the same species found under different conditions elsewhere; but field observations on tropical Membracidae are somewhat scanty, and if only for this reason, the following notes may be worth recording.

Following Professor Poulton, let us take first the genus *Membracis*. All the forms collected at Kartabo are comparatively large and conspicuous insects, black, usually variegated with white, and in one instance (*M. fasciata*) with orange. Professor Poulton suggests that the foliaceous pronotum may resemble one of the semicircular pieces of leaf that the leaf-cutting ants carry in procession to their nests. This theory, though ingenious, is hardly acceptable to anyone who has seen the supposed mimics and models in their natural haunts, although it is true that the ants will carry off, not only blackened leaves, but also bits of stick and petals of flowers. The general type of colouring that prevails throughout the genus is bold and striking, and by no means harmonizes with the surroundings. This kind of colouring is usually supposed to be associated with

"unpalatableness,"[4] and I advance another explanation, which is, however, quite hypothetical. These Membracids are gregarious, and adults and young frequently feed together on the same twigs. The young forms are covered with a white flocculent powder, which renders them so conspicuous that we can only suppose that enemies which hunt by sight recognize them as unpalatable and pass them by. The colour pattern of, say, *M. tectigera* is bold enough by itself, but when seen upon a plant infested with nymphs of its own kind, it possibly has some cryptic value, falling into line, not with its vegetable surroundings, but with its own conspicuous and unpalatable brood. I put forward this theory with reserve, for it could hardly apply to the orange and black species with whose bionomics I am not acquainted; but it would cover the case of *Enchenopa lanceolata*, also a black and white form, with a curved frontal horn, which bears not the least resemblance to a cut leaf. This species has likewise mealy white young, and forms conspicuous colonies on low-growing plants.

On the other hand, Atta mimics may well exist, and the instance observed by Slater (Poulton, *Proc. Zool. Soc.*, p. 4, June, 1891) may be a case in point. Infestation by *Amastris elevata* has a superficial resemblance to an Atta raid in progress. The green crescentic forms of the Membracidae are certainly very like pieces of cut leaf, and as the colonies are usually attended by ants, the *mise en scene* is complete. But it seems unnecessary to interpret this as mimicry of harvesting ants. The colour and form of the Membracids are equally well adapted to resemble leaf stipules, or the foliaceous expansions of the stem which are sometimes found in green plants, and this I believe to be the real explanation. Other forms in my collection to which this applies are *Cymbomorpha vaginata, Telamona spinigena, Hille herbicola* and *Gelastigonia hirsuta*. It may be remarked that all those species were taken only on green plants. *Amastris vismia*, a brown species close to *A. elevata* in all but colour, was taken only on the reddish twigs of *Vismia ferruginea*.

The suggestion that the general form and colour of genera such as *Enchenopa* and *Tropidocyta* are cryptic is supported by my field observations. *T. neglecta* and *Campylenchia nutans* fed in the axils

[4] Mottram (*Proc. Zool Soc.*, p. 253, 1917), has sought to determine experimentally the factors which cause animal colour patterns to appear conspicuous in nature. According to his conclusions such a form as *M. c-album* must be considered eminently conspicuous, for it is black with white superimposed upon it, and one at least of the component colours is nearly circular in outline.

of leaves, and simulated buds or stipules. The long-horned forms such as *E. albidorsa* and *E. monocercus* resembled broken petioles or thorns, though it should be remarked that in every case the host plant itself was thornless. *Aconophora compressa*, which is superficially similar in shape to the last two species, likewise resembled a bit of stick; and the nymphs, which have short red horns, fed in rows along the stems and were very thorn-like.

The question of the colour background is of interest. Most of the Membracids collected fed, not on the green leaves, but on the brown or reddish stems of the plants, and I never found a bright green Membracid on a brown stem. A certain slender straggling tree, common in open places, had the twigs and undersides of the leaves covered with rusty brown powder. This tree was the chosen host of many Membracidae, themselves all brown. Such were *Enchenopa monoceros, Campylenchia nutans, Aconophoroides gladiator, Centruchoides felinus*, and the solitary form *Stegaspis laevipennis*, which was almost indistinguishable from a leaf stipule. On the other hand *Stictocephala indeterminata, Aphetea affinis, Amastris elevata*, etc. appeared only on green stems or twigs. Nevertheless complete colour harmony with surroundings is not nearly so important (speaking from the point of view of a human being) as some students of animal coloration would have us believe. One is gradually forced to the conclusion that an insect with variegated pattern can pass muster very well anywhere in the chequered light and shade of the forest, among the bewildering profusion of vegetable shapes and forms. For instance, the remarkable genera *Pterygia* and *Hypsoprora* are roughly sculptured and coloured black and white, a form and pattern which, if seen in a museum, would immediately suggest imitation of a natural background of lichened bark. Unfortunately I obtained only one example of each genus, but in each case the insects were taken on green foliage. The *Pterygia* was actually feeding at the base of a leaf some distance from the ground, and until I took it in the net, I mistook it for a resting beetle or microlepidopteron, deceived by the long antenna-like supra-humeral processes. The *Hypsoprora* resembled a bit of fallen bark or a bird dropping; but in this case I am not sure that the insect had not been disturbed by my passage, and alighted momentarily on the leaves.

Sphongophorus is represented in the collection by *S. guerini*. This grotesque insect was found singly on the shoots of shrubs and

herbaceous plants in clearings, and bears an undoubted resemblance to a broken or withered leaf stem.

Species of the genus *Umbonia* have been compared to red-striped thorns. *U. spinosa* has been taken at Kartabo, but I did not find it myself, and made no field observations. There seemed to be no common plant with thorns of this type. *Aconophoroides gladiator*, which has a brown striated body and a sharp red-tipped horn, was found on brown thornless twigs. In both cases colour alone probably affords adequate concealment, and the shape of the pronotum is relatively unimportant.

The genera *Boethoos*, *Vanduzea*, and *Stictocephala* were generally represented at Kartabo by small forms whose colour and pattern, while inconspicuous, did not appear to have any special cryptic or mimetic design. The same applies to various species of Tragopinae. Some of these Membracids form colonies and are attended by ants under shelters of vegetable debris; others feed openly on leaves and stems. It must not be overlooked that forms which are individually inconspicuous may be quite obvious when present in numbers. A single example of *Tragopa cimicoides*, for example, is easily missed; but a branch where the egg-laying females cluster like berries is a comparatively striking object.

Ceresa vitulus and its variety *minor* were abundant in the sun-bleached herbage of clearings. Their greenish colour serves to conceal them, and the sharp supra-humeral spines suggest that they would be unpalatable to some enemies.

The habits of *Bolbonota* are interesting. Professor Poulton thus comments on the genus: "They closely resemble seeds, also small lumps of earth. They would be well-concealed upon rough bark." According to my observations, *Bolbonotae* of all species sat in plain view on the broad leaves of *Aspidistra* and other plants in open trails and clearings. In spite of their small size, they were visible several feet away; but they were not readily recognized because they closely resembled the little shrivelled scales and bits of bark which fell in profusion from the foliage overhead. They were very active, taking wing at the least alarm, and when they were present in numbers, the pit-pat when they alighted on the leaves was plainly audible. *Tropidocyta bulbosa* was frequently taken in the same places. In fact, from the point of view of habits, this species is very closely related to *Bolbonota*.

Darnis partita and *D. latior* are solitary when adult, and are both conspicuously coloured black and yellow forms. They feed in the axils of leaves in the shade of the forest. Certain other Homoptera, for instance, some of the Cercopidae and Jassidae, which haunted the deeper forest, likewise tended to conspicuous patterns of black, red and yellow.

Stegaspis and *Lycoderes* are both cryptically coloured genera. *Lycoderes hippocampus*, which fed in the axils of leaves of low-growing plants, was a fine example of resemblance to a bract or stipule. *S. galeata* is beautifully fashioned like a bit of dead leaf. The sexes are dimorphic, since the male has no pronotal horn and the nymph is a remarkable form with foliaceous legs and an elongated abdomen with ctenate lateral lobes. It feeds closely pressed against rough twigs with which its colour harmonizes admirably and the comb-like processes which clasp the stem on either side further tend to obscure its outline. *Bocydium globulare* was not uncommon, but I am unable to suggest an explanation of its extraordinary form. It was a solitary and comparatively active species, usually found a few feet from the ground. At first sight I occasionally mistook it for a Culicid or other small Dipteron, though to suggest mimicry here is hardly justified. That remarkable insect, *Heteronotus armatus* and its allies must be regarded as mimics of Hymenoptera. This species frequented the upper surfaces of leaves in open sunny places. They took wing with a loud buzzing noise and were capable of considerable, though slow, flights. Their appearance when flying is much like that of a large Chalcid or yellow Aculeate, and it is quite possible that we have here an example of Mullerian rather than of Batesian mimicry, for the spines of the pronotum are capable of inflicting a sharp stab when the insect is handled. The resemblance to a Hymenopteron is less striking when the Membracid is at rest, as it lacks the quick jerky movements of a wasp. Perhaps in compensation for this *Heteronotus* is wary and readily takes wing. This applies also to the curious species *Cyphonia clavata*, which was not exactly gregarious, although several individuals were generally to be found on the same bush. The resemblance to an ant is as striking in the field as in the cabinet, but, having achieved the appearance of the model, the mimic fails to reproduce its behaviour. It feeds chiefly on the undersides of the leaves in open places, and as it is sedentary, unlike the restless ants, which it should be remarked are common on the foliage round it, its immobility tends to betray it.

But like *Heteronotus*, it is wary, and a rustle, such as would be produced by a bird alighting on the bush, is sufficient to send every Cyphonia into the air.

I agree with Professor Poulton (*Proc. Ent. Soc. London*, p. 19, 1913) that the fact that a mimic does not reproduce the actions of its supposed model, is no argument for assuming that the resemblance between them is due to chance; and where an insect is structurally incapable of mimicking behaviour, it is interesting to find greater wariness or wing power by way of compensation, so that if the deception is detected, the mimic can fall back on its second line of defence, and take refuge in flight.

Some of the small Centrotinae show the exact reverse of the *Cyphonia* case. *Ischnocentrus niger*, *Lophyraspis fowleri*, and *Lophyraspis armata* are not in the least ant-like in form and yet they are apparently ant mimics. These forms are social and cluster thickly along twigs and stems where they are freely visited by ants. The hind legs are long, black, and curved and during feeding they are raised into the air and waved to and fro.

The casual observer has the impression of a mass of ants with restless limbs. When the plant is shaken, the ants rush hither and thither to attack, and the Membracids, which are alert and active, rush up and down with them. Without close inspection it is impossible to distinguish between the Homoptera and their attendants. Probably the action was originally nothing more than a rhythmical motion similar to what we see in sucking Aphides, and has secondarily become an effective "mimicking" device.

The association of Membracidae with ants has perhaps played a part in the evolution of their colour and form. The ants attack any creature which touches the plant, and thus undoubtedly afford protection to the colonies of Homoptera that they attend. At the same time, their bustling presence often betrays their hosts . A list, which is given in detail below, was prepared of the Kartabo Membracidae, not including those species of which only one example was obtained, or of which no notes were made. The remaining species were divided into those attended, and those not attended by ants; and each division was as far as possible classified into cryptic, mimetic and neutral forms, the last including all species which were inconspicuously coloured and yet bore no apparent resemblance to natural objects. As far as they go, the results are interesting. Out of thirty-five ant-attended species, sixteen are cryptically coloured,

three are ant-mimics by behaviour, and eleven are neutral. Certain black and white *Membracids* are included, but could not be classified. In eleven species not attended by ants, four are cryptic, four are mimetic, and two have conspicuous colouring of the type usually called "warning." *Bocydium globulare* is included, but could not be classified. The results are proportionately the same if the genus instead of the species is taken as the basis of the table.

The conclusion to be drawn is that ant-attended forms actually have less need for exact cryptic or mimetic resemblance, and thus from the point of view of colour and form tend to fall into panmixia. This division contains a high proportion of neutral forms, and none that are structural mimics of other insects. The unattended species are usually solitary; probably the ant-association was due in the first place to gregarious habits. The list included all the structural mimics, three striking examples of cryptic colouration and no neutral forms. The inference is that unattended species have greater need of protective devices.

The cases of *Bolbonota aspidistrae* and *Tropidocyta bulbosa* are of interest. The adults are well protected by habit and appearance, and are not attended by ants except when egg-laying. Then the female sits motionless, sometimes for days together, on a white egg-case many times her own size, and thus forms part of a comparatively conspicuous object. At these times, and also during nymphal life, both species are freely visited by ants. This supports the view that gregarious habits conduce to the ant-association; and that ant-attendance partly compensates for imperfect cryptic or mimetic resemblance, and may even have helped to account for that condition.

Professor Poulton holds the view that the remarkable forms and colours of many of the Membracidae have been produced through strict natural selection. The sanction for this selection is the assumption that the enemies of the Membracidae have visual powers at least equal to those of man. Birds and reptiles suggest themselves as possible enemies, but evidence on this head is still very scanty. The principal enemies that I observed at Kartabo were spiders, and in this connection it may be remarked that two out of the three species taken were cryptically coloured.

The present state of our knowledge is too imperfect to allow us to dogmatize, but it is difficult to believe that the number and vigi-

lance of enemies that hunt by sight can account for a natural selection strict enough to produce the mimetic forms that we think we see. I say *think we see* advisedly, because among the wealth of animal and vegetable forms in the tropical jungle, it is easy to be over-ridden by a fascinating conception, and seek mimetic interpretation where simpler explanations would suffice. It should be understood that this is not to deny the justice of many such interpretations—*Cephonia clavata* or *Sphongophorus guerini* by themselves would silence such wrong-headed scepticism—but after some time spent in the jungle, I am driven to the conclusion that any object, preferably coloured green or brown, stands a reasonable chance of being overlooked.

The advocates of protective resemblance by natural selection urge that the selection is so strict that the least deviation from the optimum is wiped out. But critics of this theory have frequently pointed out that in the earlier stages there can have been no such close likeness to the model, and yet the mimic survived. Further, the more closely the mimic approached to the model, the less strict would the selection become, because the chance of escaping enemy scrutiny would be greater. I confess that, in spite of *Cyphonia clavata* and *Sphongophorus guerini*, I find this objection unanswerable at present.

Species Attended by Ants.

Enchenopa monoceros	
" *bifenestrata*	
Campylenchia nutans	
Bolbonota aspidistrae	
" *inaequalis*	
Tropidocyta bulbosa	
Aconophoroides gladiator	
Aconophora compressa	cryptic
Amastris elevata	
" *vismiae*	
Gelastigonia hirsuta	
Hille herbicola	
Aphetes affinis	
Centruchoides felinus	
Stegaspis galeata	
Aethalion reticulatum	
Ischnocentrus niger	
Lophyraspis fowleri	mimetic
" *armata*	

Tropidocyta gibbosa	
Vanduzea testudinea	
Boethoos distinguenda	
" *reticulata*	
Tragopa cimicoides	
" *scutellaris*	neutral
" *guianae*	
" *tripartita*	
Horiola arcuata	
Endoiastus productus	
Tropidaspis carinata	
Membracis c-album	
" *fusca*	
" *tectigera*	not classified
" *arcuata*	
Enchenopa lanceolata	

Species Not Attended by Ants.

Lycoderes hippocampus	
Stegaspis laevipennis	
Sphongophorus guerini	cryptic
Ceresa vitulus	
Heteronotus armatus	
" *albospinosus*	mimetic
" *vespiformis*	
Cyphonia clavata	
Darnis partita	non-mimetic, ? warning
" *latior*	
Bocydium globulare	not classified

The Nymphal Forms.

The nymphs of the neotropical Membracidae are not often seen in collections; for owing to their soft bodies, they do not make satisfactory pinned specimens, and the collector, unless he is especially interested in the group, passes them by in favour of the adults. The development of some North American species, however, has been studied in detail, notably by Funkhouser (*Cornell Univ. Agric. Exp. Sta.*, mem. II, 1917)

The nymphs of most species, as far as is known, are imperfect editions of the adult form, and already the 4th and 5th instars fore-

shadow, as it were, the horn of *Enchenopa*, the rounded hood of *Boethoos* and *Tropidocyta*, the lateral processes of *Tragopa*, etc. The colouring also follows that of the adult in a general way. For instance, the nymphs of *Hille herbicola* and *Amastris elevata* are green, while those of *Enchenopa monoceros* and *Campylenchia nutans* are brown. The fact that the resemblance of form is less exact than that of colour supports the view that in many instances the Membracidae escape notice more by a general harmony with their surroundings than by definite resemblance to particular objects. The soft-bodied nymphs, which seem to need at least as much protection as the hard-bodied adults, often live side by side with the latter in the same environment, and yet lack those details of form and pattern which give their parents such wonderful likeness to surrounding objects; and which, we are sometimes told, are necessary to concealment, owing to the strict natural selection to which the species has been exposed.

We are hampered in any discussion of this subject by our ignorance of the early stages of some of the most wonderful of the "protected" species, such as *Hypsoprora*, *Sphongophorus*, *Heteronotus*, and certain *Lycoderes*. Nevertheless it is perhaps safe to venture on the generalization that as a rule conspicuously coloured adults have conspicuous nymphs and vice versa, although the conspicuousness is not always produced in the same way. For instance, at Kartabo, the black and white forms, *Membracis* and *Enchenopa lanceolata*, have nymphs with a white flocculent covering, frequently spotted with black. In the same way, adults which are cryptic as a rule possess nymphs which are cryptically, or at all events "neutrally" coloured. The only Kartabo species whose nymph is more brightly coloured than the adult is *Aconophora compressa*, in which the young of the 4th and 5th instars have rudimentary sharp red-tipped horns, and are decorated with white patches. It is possible that the frequent association with ants, as suggested elsewhere in this paper, may partly compensate for the absence of special protective devices in the nymphs of some species.

But certain forms do possess adaptive characters peculiar to the nymphal stages. Such are the pectinate lateral processes of *Stegaspis galeata*, which clasp the stem and undoubtedly tend to obliterate the outline of the insect; and the ? *Stegaspis* nymph, figured by Poulton (*Proc. Zool. Soc.*, p. 462, 1891) as an Atta mimic is perhaps another example of especial cryptic adaptation during development. Fowler

(*B.C.A.*, p. 4, 1909) remarks that the nymphs of *Membracis* "are very curious, being of the same shape as the perfect insect, but formed of separate upright narrow plates of different heights." This general statement is probably based on the remarkable specimen in the Hope Museum, figured by Buckton (*Mon. Membracidae*, pl. II, 4a) as the nymph of *M. continua;* but this form is not invariable for the genus, since the nymph of a typical species such as *M. c-album* is quite different in appearance, and has a semi-circular hood.

The nymphs of many genera possess dorsal spines which may be defensive in function. The number and arrangement vary a good deal even within the genus. For instance, according to Funkhouser, the nymph of *Campylenchia latipes* is furnished with broad median dorsal plates, whereas the nymph of *C. nutans* possesses long curved paired spines on the 2nd and 3rd abdominal segments, and near the orifice of the anal tube. These anal spines are remarkable and nothing is known of their function.

Enchenopa monoceros has a double row of little bristly lappets along the dorsum; *E. bifenestrata* is covered only with a short pilose coat; *Tragopa cimicoides, Amastris elevata* and *Gelastigonia hirsuta* are spineless; *Bolbonota inaequalis* has a double row of minute bristles; *Aconophora compressa* has a pair of strong curved spines on the mesothorax and on abdominal segments 2–4. The white nymphs of *Membracis* and *Enchenopa lanceolata* are thickly spined along the dorsum, but there seems to be no correlation between the conspicuous colouring and the presence of dorsal spines, for the cryptically coloured nymphs of *Boethoos reticulata* are spinous also. There are some remarkable nymphal forms in the Hope Museum. One, figured by Buckton (*op. cit.*, pl. 19, fig. 6) as *Holophora pertusa,* has a pair of stout backwardly-projecting spines on the mesothorax only. If it really belongs to this species and not, as is more probable, to *Umbonia,* it is of interest because the pronotum is developed into a high sharp point above the shoulders, which is lacking in the adult. Another specimen, labelled *Triquetra nigrofasciatus* Buckt. possesses both meso- and meta-thoracic spines. Two very curious forms appear in the *Cyphonia* series in this collection. One has the mesothorax and abdominal segments 2–3 strongly spined, and in addition, the pronotum is produced in front into a high bifid spike. Another has strong paired spines on the metopidium, and on the posterior process, while the mesothorax and abdominal segments 2–7 are likewise armed.

The phylogenetic value of the nymphal form is very doubtful, but if we are prepared to accept such evidence, we must suppose that the Centrotinae with their exposed scutellum are nearest to the ancestral type, although the extraordinary diversity of form in the sub-family forbids us to theories. But certain Centrotinae possess a second character which is found only in the nymphs of other sub-families, namely the raised margin of the base of the head above the occiput. In *Tropidaspis carinata* this is small and only slightly lobed. In *T. minor*, the elevated part is more strongly bifid, while in *T. cornuta*, it is deeply cloven and bicornulate, almost as in *Lamproptera capreolus*. In *L. stylata* the lobes are produced into horns long enough to bear a superficial resemblance to antennae. In *Endoiastus productus* the head is laterally compressed and produced into two narrow lobes, divided by a groove. In *Lophyraspis pygmaea* the base of the head is little raised and scarcely sinuate, while in *L. armata* it is high, obtusely cuneiform, and almost straight. But the nymphs of both the last named species have the base of the head strongly divided into two conical horns as in *Tropidaspis cornuta*, and this character can be seen in the nymphs of other sub-families at certain stages. In *Amastris elevata*, for example, it is not distinguishable after the second or third instar, but in *Enchenopa bifenestrata* it persists up to the fourth.

The wing venation of some of the Centrotinae, such as *Bocydium*, *Lycoderes* and *Centruchoides*, is in its way as specialized as that of the other sub-families, but the venation of the *Tropidaspis-Lophyraspis* group, although it has suffered the modification by reduction common to all the Membracidae (Funkhouser, *Ann. Ent. Soc. Amer.*, vol. VI, no. 1) is in some respects more generalized. There is apparently no anastomosis between radius, media and cubitus, save that in *Lophyraspis* the two former are united for the basal third of their length. The important inter-radial and medio-cubital cross-veins occupy typical positions, and the only other cross-vein is a radio-medial as in some Membracinae. Mr. Funkhouser, in his valuable paper cited above, figures the wing pad of the nymphs of some species, and it is impossible not to notice that the venation of the adult *Tropidaspis* follows the primitive tracheation of more specialized forms, especially as regards the tracheation of the hind wing, which, although the venation is reduced, is in some respects more generalized than the tegmen.

Key to Species Included in this Paper.

The following key to the species included in this paper is intended primarily for field workers in British Guiana, and is therefore necessarily somewhat arbitrary. It is based on the keys of Fowler in the Biologia-Centrali-Americana, but I have relied as far as possible upon the form and colour of the pronotum, rather than upon the characters of the venation, which are often confusing to those who have not previously studied the group.

(B) A. Scutellum wanting, or obsolete, or entirely concealed by the pronotum.[5]
(53) 1. Tarsi of equal length, or with the posterior pair the longest.
(21) 2. Anterior tibiae dilated and foliaceous (Membracinae).
(6) 3. Pronotum foliaceus, elevated, semi-circular or nearly so when seen from the side (*Membracis*).
(5) 4. Black, or black and white.
a. Entirely black .... *Membracis fusca.*
b. With an oval, and a crescentic, white spot . *Membracis c-album.*
c. With two oval white spots .... *Membracis carinata.*
d. With a horizontal white band .... *Membracis arcuata.*
e. Anterior border and a spot on the dorsum, white. *Membracis tectigera.*
f. With two quadrate white spots on the dorsum *Membracis humilis.*
(4) 5. Black, variegated with orange .... *Membracis fasciata.*
(3) 6. Pronotum not rounded, nor foliaceous nor elevated when seen from the side.
(12) 7. The pronotum produced in front into a longer or shorter horn. (*Enchenopa*).
(11) 8. Dorsum even when viewed from the side.
(10) 9. Horn not lobed at the apex.
a. Colour chestnut: horn long .... *Enchenopa monoceros.*
b. Colour fawn-brown: horn curved .... *Enchenopa nutans.*
c. Colour black with a white band on dorsum *Enchenopa albidorsa.*
d. Colour orange or red: horn short ...... *Enchenopa pulchella.*
e. Colour black, with white dorsal spots . *Enchenopa lanceolata.*
f. Horn short and stout: black with dirty-white mark on dorsum ...... *Enchenopa bifenestrata.*
(9) 10. Horn bi-lobed at apex: legs not very foliaceous (*Lycoderes, Centrotinae*).
a. Horn stout: form triangular: colour brown *Lycoderes laevipennis.*
b. Horn black and slender: abdomen green *Lycoderes hippocampus.*

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[5] The genera *Lycoderes* and *Stegaspis* properly belong to the sub-family Centrotinae, which has the scutellum developed and uncovered: but the foliaceous species included here are so readily confused with some of the Membracinae, that it has been thought better to place them in the first part of this key.

(8) 11. Dorsum tuberculate when seen from the side.
Horn truncate at the apex.
a. Black and white: very asperate: not laterally compressed *Hypsoprora aspera.*
b. Black or brown: foliaceous: much compressed laterally. (No horn in male)...... *Stegaspis galeata* [Centrotinae].

(7) 12. Pronotum not horned in front.

(14) 13. Pronotum with fungiform processes on dorsum. Head 3-lobed. (*Sphongophorus*) with the processes resembling the capital letters EL.... .... *Sphongophorus guerini.*

(13) 14. Pronotum without fungiform processes.

(16) 15. Pronotum with two long lateral processes above the shoulders, and a sharp tubercle at the posterior apex. Black and white *Pterygia uropygii.*

(15) 16. Pronotum without lateral processes above the shoulders.

(20) 17. Pronotum obtusely angulate or rounded in front and strongly carinate. Dorsal ridge even, when viewed from the side. Legs scarcely foliaceous.

(19) 18. Tegmina with three discoidal areas (*Tropidocyta*).
a. Covered with white tomentose hairs...*Tropidocyta pruinosa.*
b. Legs and pronotum pale ochreus, with an ill-defined brown patch on dorsum. On distorted shoots *Tropidocyta gibbosa.*
c. Small and globose: dark brown: pronotum rounded in front, as in the last..................*Tropidocyta bulbosa.*
d. Rather larger than the last two, and with the pronotum obtusely angulate in front..... *Tropidocyta neglecta.*

(18) 19. With two discoidal areas, but otherwise resembling the last genus (*Leiocyta*).
a. Pale, with a large bright chestnut mark on the dorsum *Leiocyta beebei.*
b. Brown, with two ill-defined darker spots on the dorsum *Leiocyta spiralis.*

(17) 20. Form very small and globose: pronotum rounded in front and corrugated, rugose or tuberculated on the dorsum. Colour black or dark brown (*Bolbonota*).
a. Very small: with the tegmina entirely transparent *Bolbonota inaequalis.*
b. Larger: tegmina opaque, and often spotted with yellow: dorsum corrugated................*Bolbonota pictipennis.*
c. As in (b): dorsum with two carinated tubercles *Bolbonota aspidistrae.*
d. As in (c) but with the tubercles less high, and expanded transversely......................*Bolbonota corrugata.*

(2) 21. Anterior tibiae not foliaceous.

(33) 22. Central (3rd) apical areole of the tegmen elongate, and truncate at its base. (Darninae.)

(32) 23. Tegmina not more than half as long as wings: pronotum not nodose nor spined.

(27) 24. Pronotum covering at least half of corium: head much broader than long.

(26) 25. Colour black and yellow: surface polished.
- a. With three transverse dorsal yellow bands.. *Darnis partita.*
- b. With the lateral margins only yellow........ *Darnis latior.*

(25) 26. Colour green.......... .... *Stictopelta indeterminata.*

(24) 27. Tegmina almost free.

(29) 28. Pronotum with a long horn: superficially resembling *Enchenopa* *Aconophora compressa.*

(28) 29. Pronotum without a horn: colour green.

(31) 30. Pronotum compresso-elevate, semi-circular in side view *Cymbomorpha vaginata.*

(30) 31. Pronotum not elevated, but tectiform and convex *Rhexia kartabensis.*

(23) 32. Tegmina twice as long as wings: pronotum nodose and spined (*Heteronotus*).

Black and yellow wasp-like forms
- a. With the posterior spines comparatively short and stout *Heteronotus armatus.*
- b. With the posterior spines longer and more slender *Heteronotus vespiformis.*
- c. With the spines as in the last, but paler, and the form of the of the nodes somewhat different.. *Heteronotus albispinosus.*

(22) 33. The central (3rd) apical areole of the tegmen petiolate, that is to say, enclosed by a forked (Y-shaped) vein.

(39) 34. Tegmina very coriaceous externally, with the veins scarcely distinguishable, and the free margins broad (Tragopinae).

(38) 35. Tegmina almost entirely concealed by the pronotum (*Tragopa*).

(37) 36. Shoulders produced: colour greenish brown.
- a. Shoulders very prominent.............. *Tragopa cimicoides.*
- b. Shoulders less pronounced.............. *Tragopa scutellaris.*

(36) 37. Shoulders not produced: colour various.
- a. Entirely black.......................... *Tragopa occulta.*
- b. Greenish: broadly marked with brown on the dorsum *Tragopa guianensis.*
- c. Colour very variable, ranging from black to red; and the pattern also very diversified.......... *Tragopa tripartita.*

(35) 38. Tegmina with the external half free (*Horiola*).
- a. Chestnut, with a pale saddle-shaped mark.. *Horiola arcuata.*
- b. Bright brown, with the shoulders outlined with yellow *Horiola ferruginea.*

(34) 39. Tegmina membranous or coriaceous only along the external margin: veins distinct (Smiliinae).

(43) 40. Tegmina with the clavus uncovered.

(42) 41. Posterior process of the pronotum trifurcate (*Cyphonia*).

Ant-like forms
- a. Pronotum entirely black................. *Cyphonia clavata.*
- b. With a white spot on either side of the prothorax *Cyphonia nasalis.*

(41) 42. Pronotum not trifurcate, but rounded, and furnished with two humeral spines. Colour greenish............*Ceresa vitulus.*

(40) 43. Tegmina with the clavus, and more or less of the corium, covered.

(47) 44. Pronotum horned in front.

(46) 45. Horn erect: colour green.

a. Surface glabrous, not hairy nor costate..*Hille herbicola.*

b. Surface hirsute and costate............*Gelastigonia hirsuta.*

(45) 46. Horn projecting obliquely forwards: colour brown, with yellow costae..........................*Polyglyptodes flavicostatus.*

(44) 47. Pronotum not horned.

(49, 50) 48. Pronotum compresso-elevate, semicircular in side view.

a. Green ....*Amastris elevata.*

b. Brown ....*Amastris vismiae.*

(50) 49. Pronotum compresso-elevate, not semicircular in side view.

a. With an obtusely angulate process above the dorsum - *Telemona spinigera.*

b. Flattened in front and raised and carinate behind *Amastris funkhouseri.*

(48, 49) 50. Pronotum not compresso-elevate, but convex, tectiform, though scarcely keeled.

(52) 51. Ground colour black or brown, variegated with white or yellow.

a. Large, hairy, with a transverse yellow dorsal band *Boethoos cinctata.*

b. Smaller than the last, and with a lateral yellow spot or streak *Boethoos distinguenda.*

c. Black, variegated with white..........*Boethoos reticulata.*

d. Brown, with the dorsum depressed behind the middle *Boethoos globosa.*

(51) 52. Ground colour green, or sordid white.

a. Hairy, and broadly marked across the dorsum with chestnut *Vanduzea testudinea.*

b. Very small: colour green or sometimes brown..*Aphetea affinis.*

(1) 53. Posterior tarsi much shorter than the other pairs (Holophorinae).

(55) 54. Wing with four apical cells: horn projecting forwards: colour brown *Aconophoroides gladiator.*

(54) 55. Wing with three apical cells: horn situated on the middle of dorsum: colour green..........................*Umbonia spinosa.*

B. Scutellum distinct, and more or less uncovered by the pronotum.

(13) 1. Either or both the pronotum and scutellum armed with processes, crests, or carinae.

(3) 2. Pronotum armed with a posterior process; scutellum unarmed.

a. Posterior process of the pronotum lying close to the abdomen and extending almost to the apex of the latter: a pair of broad lateral processes above the shoulders *Centruchoides felinus.*

b. Posterior process long and styliform, remote from abdomen, and springing above the head from an erect process, which

is furnished in front with four black petiolated swellings. *Bocydium globulare.*

c. Posterior process short and spike-like, and hardly reaching half way along the abdomen. Size small: hind tibiae long, black, curved, and covered with minute regular spines *Ischnocentrus niger.*

(2) 3. Pronotum without a posterior process: scutellum unarmed.

(5) 4. Pronotum armed with two lateral processes in front: scutellum pale *Tolania scutata.*

(4) 5. Pronotum without lateral processes.

(7, 12) 6. Either or both the pronotum and scutellum provided with a pronounced median carina or crest. The hind tibiae long, curved and furnished with numerous minute spines. (*Lophyraspis, Tropidaspis.*)

(6, 12) 7. With a crest or crests.

(11) 8. Both pronotum and scutellum crested.

(10) 9. The crests sharp, high, recurved and bordered behind with white.

a. The two crests of equal height.........*Lophyraspis armata.*

b. The crest of the pronotum highest: size smaller *Lophyraspis pygmea.*

(9) 10. The pronotal crests rounded and inclined forwards: not bordered with white behind: scutellum not crested but strongly carinate *Tropidaspis cornuta.*

(8) 11. The scutellum alone furnished with a crest, which is erect, compressed, and bordered with white behind .*Lophyraspis fowleri.*

(6) (7) 12. Pronotum and scutellum not crested but carinate.

a. Upper margin of the head sinuate ...*Tropidaspis carinata.*

b. Upper margin of the head bi-lobed: size smaller *Tropidaspis minor.*

(1) 13. Pronotum and scutellum either completely unarmed, or at most faintly carinate.

a. Size rather large and square: colour brown: venation thickened and reticulate: legs without spines, and yellow, conspicuously spotted with black: upper margin of head almost flat . ...*Aethalion reticulatum.*

b. Size very small and elongate: colour bronze black: tegmina opaque, but venation not reticulate: upper margin of head produced into two narrow lobes .*Endoiastus productus.*

No. 4 of Vol. 6 missing

THE ISOPODS OF KARTABO[1]* BARTICA DISTRICT, BRITISH GUIANA*

By Willard G. Van Name

(Plates VII–XXVI incl.)

The American Museum of Natural History has received from William Beebe, Director of the New York Zoological Society's Tropical Research Station at Kartabo, British Guiana, a number of Crustacea of various groups collected in the course of the investigation of the fauna of the immediate vicinity of the Station. The Isopoda collected, comprising fourteen species and several additional specimens so immature that their certain determination is difficult, are described in the following pages. The collection is of special interest, as no less than six of them appear to be new to science, and because comparatively little has been recorded regarding the isopods of that part of South America, although it doubtless has a large representation of both land and aquatic isopods.

The following Isopoda are comprised in the collection:

Suborder Chelifera

Family TANAIDAE

Nototanais beebei, sp. nov

Suborder Flabellifera

Family EXCORALLANIDAE

**Excorallana berbicensis* Boone, 1918.

Family CYMOTHOIDAE

Livoneca symmetrica, sp. nov.
Livoneca guianensis, sp nov.
Telotha henselii (von Martens), 1869.

Suborder Epicaridea

Family BOPYRIDAE

Probopyrus bithynis Richardson, 1904.

Suborder Oniscoidea

Family ONISCIDAE

Subfamily Eubelinae

**Ethelum americanum* (Dollfus), 1896.

[1] Contribution from the Laboratory of the Department of Lower Invertebrates of the American Museum of Natural History, New York.

* Contribution, Department Tropical Research No. 194.

Subfamily ONISCINAE

Leptotrichus pittieri Pearse, 1921.
**Circoniscus gaigei* Pearse, 1917.
**Philoscia nitida*[2] (Miers), 1877.
Philoscia maculata[2] Budde-Lund, 1885.
Philoscia demerarae sp. nov.
Pentoniscus exilis, sp. nov.

Family LIGYDIDAE

Ligyda platycephala sp. nov.

Those of the above that have already been recorded from any part of Guiana (including the British, Dutch and French possessions) are indicated by an asterisk. The entire list of Isopoda hitherto recorded from that region comprises, as far as I am aware, only the following twenty-two species, eleven of which have been definitely credited to British Guiana. (See "Bibliography" at end of this article.) The present article raises these numbers to thirty-two from the whole of Guiana and twenty-two from British Guiana.

ISOPODS ALREADY RECORDED FROM GUIANA.

Suborder FLABELLIFERA

Family EXCORALLANIDAE

Excorallana berbicensis Boone, 1918.

Excorallana berbicensis Boone, 1918, *Proc. U. S. Nat. Mus.*, LIV, *p.* 594 *pl.* XCII, *fig.* 1.

Locality.—Rio Berbice, British Guiana.

Represented also in the present collection from Kartabo.

Family CYMOTHOIDAE

Livoneca redmanni Leach, 1818.

Livoneca redmanni + *L. desmarestii* Leach, 1818, *Dict. Hist. Nat.* XII, *p.* 352; Desmarest, 18[illegible], *Con. gen. Crust.*, *p.* 308; Milne-Edwards, 1840, *Hist. Nat. Crust.*, III, *p.* 261; also in *Cuvier*, *Regn Anim.* III, *pl.* LXVI, *figs.* 3–3e, 4–4a.
Livoneca redmanni Schioedte and Meinert (part), 1884, *Nat. Tidsskr.* (3) XIV, *p.* 353, *pl.* XIV, *figs.* 6–12; Richardson, 1900, *Amer. Naturalist*, XXXIV, *p.* 221; 1901, *Proc. U. S. Nat. Mus.*, XXIII, *p.* 531; 1905, *Bull.* 54, *U. S. Nat. Mus.*, *p.* 261, *figs.* 274, 275.

Locality.—Guiana (Schioedte and Meinert); also West Indies and Brazil

Suborder ONISCOIDEA

Family ONISCIDAE

Philoscia spinosa, Say, 1818.

Philoscia spinosa Say, 1818, *Journ. Acad. Nat. Sci. Philadelphia*, I, *p.*

[2] Identification somewhat uncertain owing to the insufficient description.

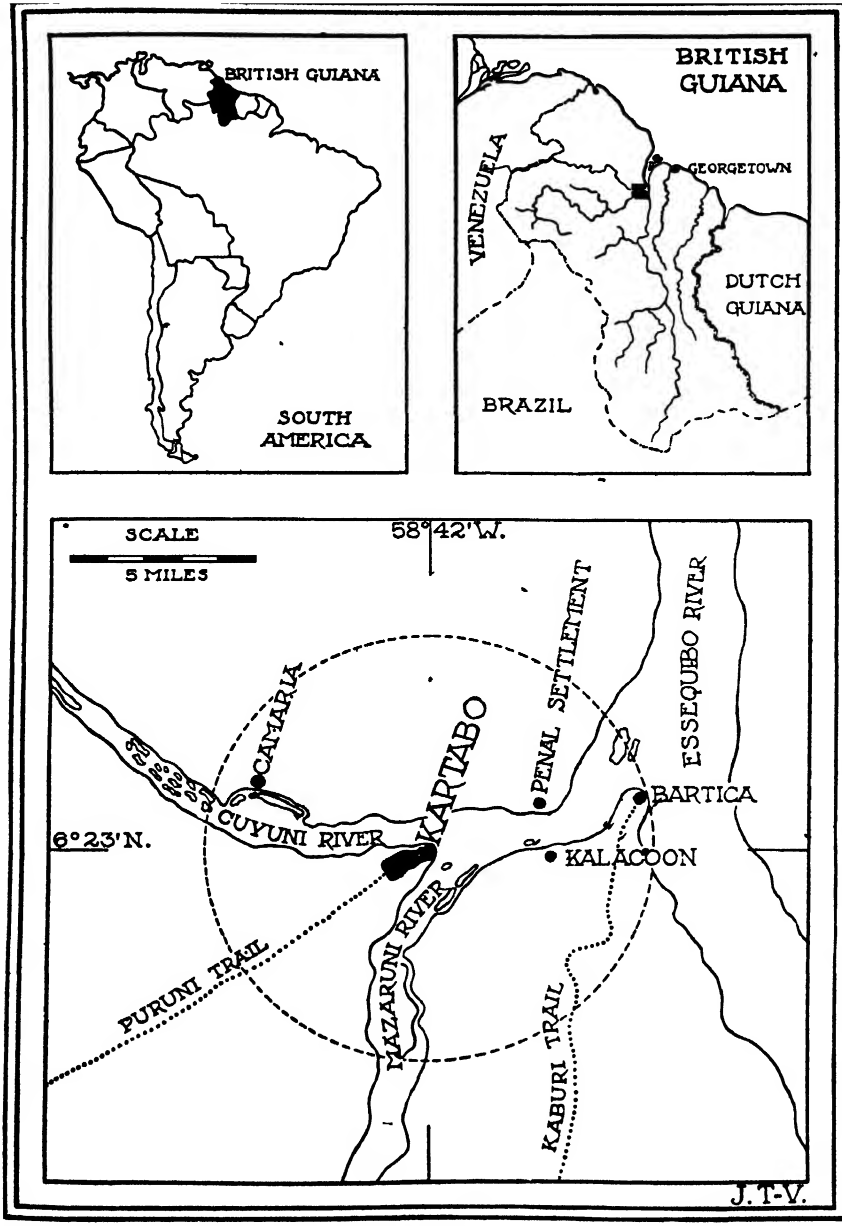

Plate A. British Guiana Tropical Research Station of the New York Zoological Society. Circle represents a radius of six miles.

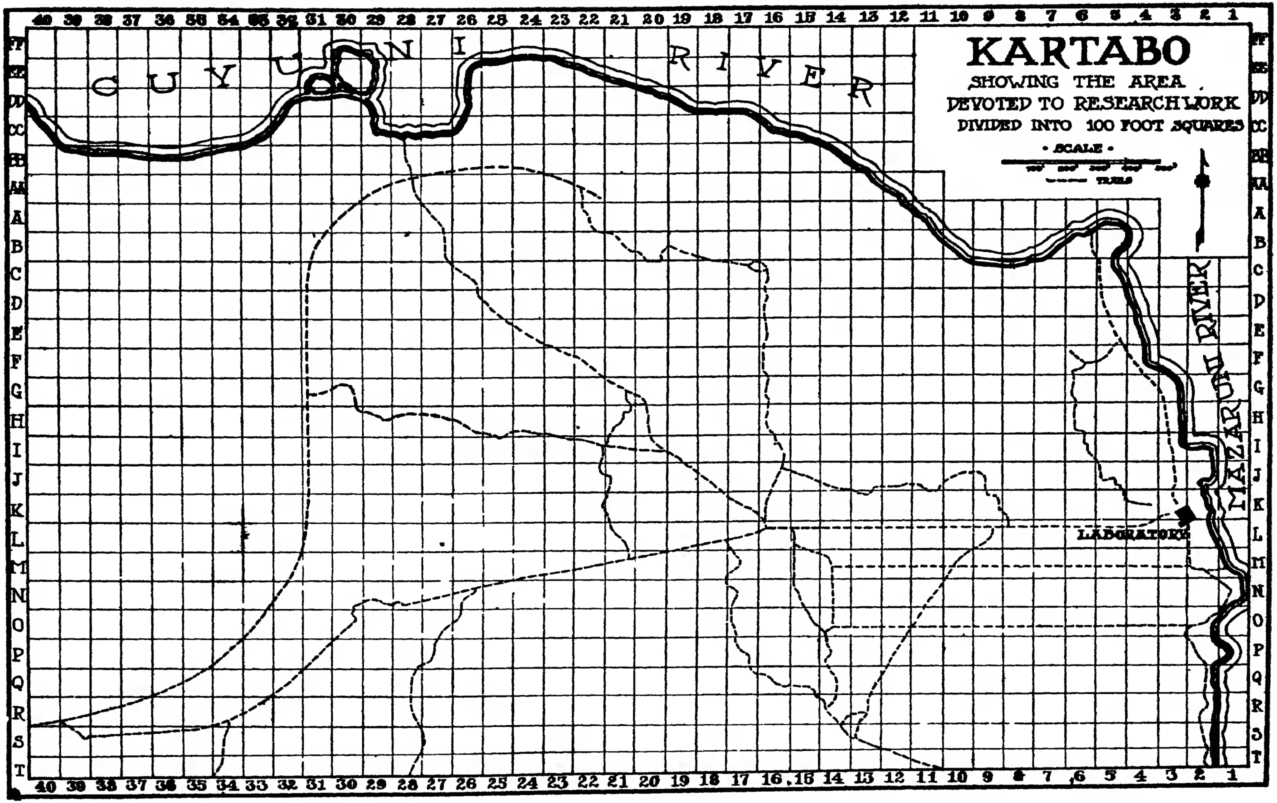

Plate B Area devoted to research at Kartabo.
Drawing by John Tee-Van.

429; Pearse, 1917, *Occ. Papers Mus. Zool. Univ. Michigan*, No. 46, *p.* 7. For other references, see Richardson, 1905, *p.* 608, and Budde-Lund, 1885, *p.* 223.

Locality.—Savannah, Georgia (Say, 1818); Dunoon, British Guiana, "from wet rotten logs in clay jungle, and rotten wood on ground in the Labba Creek sandhills" (Pearse, 1917).

Philoscia olfersii Brandt, 1833.

Philoscia olfersii Brandt, 1883, *Consp. Monogr. Crust. Onisc.*, *p.* 21; Budde-Lund, 1885, *Crust. Isop. Terr.*, *p.* 212; Pearse, 1917, *Occ. Papers, Mus. Zool. Univ. Michigan*, No. 46, *p.* 7.
For other references see Budde-Lund, 1885.

Locality.—Brazil (Brandt); Dunoon, British Guiana. "In wet rotten logs and under fallen leaves" (Pearse, 1917).

Philoscia nitida (Miers), 1877.

Philougria nitida Miers, 1877, *Proc. Zool. Soc. London*, ann. 1877, *p.* 670, *pl.* LXIX, *figs.* 3-3*b*.
Philoscia nitida Pearse, 1915, *Proc. U. S. Nat. Mus.*, LXIX, *p.* 542.

Locality.—"Peru; Guiana. The specimens from Guiana generally appear rather more coarsely granulated" (Miers, 1877). Santa Marta region, Colombia (Pearse, 1915). "This was an abundant species in the forest from 'La Rosa'" to the top of San Lorenzo [8000 feet]. It was usually found on the ground among leaves or under logs, but was also taken on tree trunks, in brooks and in bromeliads. At the top ot San Lorenzo it was found in the ground under leaves and in a little brook that started there. Those taken at high altitudes are darker in color in alcohol" (Pearse, 1915).

Specimens in the present collection from Kartabo appear to belong to this species.

Porcellionides brunneus (Brandt), 1833.

Procellio brunneus Brandt, 1833, *Bull. Soc. Imp. Nat. Moscou*, VI, *p.* 176. Milne Edwards, 1840, *Hist. Nat. Crust.*, III, *p.* 172. Stuxberg, 1875, *Ofvers. k. svensk. Vetensk. Akad. Forh.*, XXXII, No. 2, *p.* 43.
Metoponorthus brunneus Budde-Lund, 1885, *Crust. Isop. Terr.*, *p.* 171.

Locality.—Demerara.

Porcellionides pruinosus (Brandt), 1833.

? *Porcellio (Porcellionides) jelskii* Miers, 1877, *Proc. Zool. Soc. London*, 1877, *p.* 668, *pl.* LXVIII, *figs.* 3-3b
Porcellio (Porcellionides) flavovittatus Miers, 1877, *Proc. Zool. Soc. London*, 1877, *p.* 669, *pl.* LXVIII, *figs.* 4-4*b*.
Metoponorthus pruinosus Budde-Lund, 1885, *Crust. Isop. Terr.*, *p.* 169; Richardson, 1901, *Proc. U. S. Nat. Mus.*, XXIII, *p.* 569; 1905, *Bull. 54, U. S. Nat. Mus.*, *p.* 627, *fig.* 674.
See Budde-Lund, 1885, and Richardson, 1905, for synonyms.

Localities.—Cayenne (*P. flavo-vittata* Miers, 1877); Peru and Guiana (*P. jelskii* Miers, 1877). This species is of practically world-wide distribution.

Porcellionides jelskii (Miers), 1877.

Porcellio (Porcellionides) jelskii Miers, 1877, *Proc. Zool. Soc. London*, 1877, *p.* 668, *pl.* LXVIII, *figs.* 3-3*b*.
Richardson (1905, p. 621) makes this a doubtful synonym of *P. pruinosus* (see above).

Porcellio cayennensis Miers, 1877.

Porcellio cayennensis Miers, 1877, *Proc. Zool. Soc. London*, 1877, *p.* 667, *pl.* LXVIII, *figs.* 2–2*b*.

Locality.—Cayenne.

Lyprobius cristatus (Dollfus), 1889.

Porcellio cristatus Dollfus, 1889, *Notes Leyden Mus.*, XI, *p.* 91, *pl.* V, *figs.* 2–2*d*.

Lyprobius cristatus Budde-Lund, 1893, *Ent. Meddel.*, ann. 1893, *p.* 127; Dollfus, 1892; *Ann. Soc. Ent. France*, LXII, *p.* 345.

Locality.—Surinam (Dollfus); Caracas, Venezuela (Budde-Lund).

Leptotrichus emarginatus Pearse, 1917.

Leptotrichus emarginatus Pearse, 1917, *Occ. Papers Zool. Mus. Univ. Michigan*, No. 46, *p.* 5.

Locality.—Dunoon, British Guiana. Taken under bark of trees, in axils of leaves three to ten feet from the ground, and also in loose sand (Pearse).

Cubaris murina Brandt, 1833.

Cubaris murina + *C. brunnea* Brandt, 1833, *Bull. Soc. Imp. Nat. Moscou*, VI, *p.* 28.

Armadillo murinus + *A. brunneus* Milne-Edwards, 1840, *Hist. Nat. Crust.*, III, *p.* 179.

Cubaris murinus + *C. brunneus* Stuxberg, 1875, *Öfvers. k. svensk. Vetensk.-Ak. Forh.* XXXII, No. 2, *p.* 44 (foot-note).

Cubaris affinis Miers, 1877 (non Dana, 1854), *Proc. Zool, Soc. London*, ann. 1877, *p.* 666, *pl.* LXVII, *figs.* 4–4*b*.

Armadillo murinus Budde-Lund, 1879, *Prosp. Isop. Terr.*, *p.* 7; 1885, *Crust. Isop. Terr.*, *p.* 27; 1904, *Rev. Crust. Isop. Terr.*, part III, *p.* 119.

Cubaris murina Richardson, 1901, *Proc. U. S. Nat. Mus.*, XXIII, *p.* 571; 1905, *Bull* 54, *U. S. Nat. Mus*, *p.* 645, *figs* 687–689.

See Budde-Lund, 1885, and Richardson, 1905, for other synonyms.

Localities.—Demerara (Brandt, 1833); Cayenne (Miers, 1877). Widely distributed in the tropics.

Cubaris gaigei Pearse, 1917.

Cubaris gaigei Pearse, 1917, *Occ. Papers Zool. Mus. Univ. Michigan*, No. 46, *p.* 2, *fig.* 1.

Locality.—Dunoon, British Guiana. In rotten logs and under dead leaves on the ground, and on trees under loose bark, among bromeliads, etc. (Pearse)

Sphaeroniscus portoricensis Richardson, 1901.

Sphaeroniscus portoricensis Richardson, 1901, *Proc. U. S. Nat. Mus.*, XXIII, *p.* 57[illegible], *fig.* 34; 1905, *Bull.* 54, *U. S. Nat. Mus.*, *p.* 662, *figs.* 703, 704. Pearse, 1917, *Occ. Papers Zool. Mus. Univ. Michigan*, No. 46, *p.* 3.

Locality.—Dunoon, British Guiana, on sand hills and in an abandoned termite nest (Pearse); El Yunque, Porto Rico (Richardson).

Circoniscus spinosus (Collinge), 1918.

Paracubaris spinosus Collinge, *Journ. Linn. Soc. London, Zool.*, XXXIV, *p.* 61, *pl.* VI.

Locality.—Mazakuri River, British Guiana, in decaying wood..

Though made the type of a new genus (*Paracubaris*) by Collinge, this

species is apparently hardly separable generically from *Circoniscus* Pearse, 1917, to which I am accordingly referring it.

Circoniscus gaigei Pearse, 1917.

> *Circoniscus gaigei* Pearse, 1917, *Occ. Papers Mus. Zool. Univ. Michigan*, No. 46, *p.* 4, *fig.* 2.

Locality.—Dunoon, British Guiana, in rotten logs, under bark of trees, etc. (Pearse).

Represented also in the present collection from Kartabo.

Eluma caelatum (Miers), 1877.

> *Armadillidium caelatum* Miers, 1877, *Proc. Zool. Soc. London*, 1877, *p.* 665, *pl.* LXVII, *figs.* 3–3*b*.
> *Eluma purpurascens* Budde-Lund, 1879, *Pros. Isop. Terr.*, *p.* 6; 1885, *Crust. Isop. Terr.*, *p.* 48., Dollfus, 1896, *C.-R. 3me Congres. Int. Zool. Leyden*, *p.* 357.
> *Eluma caelatum* Collinge, 1917, *Check-list British Terr. Isop.*, p. 115; 1922, *Journ. Linn. Soc. London, Zool.*, XXXV, *p.* 105, *pl.* VIII.
> See Collinge, 1922, for synonyms and discussion.

Locality.—Cayenne (Miers, 1877; Budde-Lund, 1885; Dollfus, 1896). Also in Spain, Algeria, Madeira, etc. This species is the type of the genus *Eluma*, established for it by Budde-Lund (1885, p. 48).

Armadillidium vulgare (Latreille), 1804.

> *Armadillo vulgaris* Miers, 1877, *Proc. Zool. Soc. London*, 1877, *p.* 665.
> *Armadillidium vulgare* Budde-Lund, 1885, *Crust. Isop. Terr.*, *p.* 66; Richardson, 1905, *Bull.* 54, *U. S. Nat. Mus.*, *p.* 666, *fig.* 706.
> See Budde-Lunde, 1885, and Richardson, 1905, for synonyms.

Locality.—Cayenne (Miers), 1877. This locality was given doubtfully by Miers, but does not seem unlikely, as the species is almost cosmopolitan.

Ethelum americanum (Dollfus), 1895.

> *Mesarmadillo americanus* Dollfus, 1896, *Proc. Zool. Soc. London*, 1896 *pp.* 397, 398.
> *Ethelum americanum* Pearse, 1917, *Occ. Papers Mus. Zool. Univ. Michigan*, No. 46, *p.* 1.
> For other references see descriptive part of this paper.

Locality.—St. Vincent, W. I. (Dollfus); Dunoon, British Guiana. On trees among bromeliad roots, vines, etc. (Pearse, 1917). Represented also in the present collection from Kartabo.

Family LIGYDIDAE

Ligyda exotica (Roux), 1828.

> *Ligia exotica* Roux, 1828, *Crust. Medit.*, *p.* 3, *pl.* XIII, *fig.* 9; Richardson, 1902, *Trans. Conn. Acad. Sci.*, XI, *p.* 306.
> *Ligia baudiniana ?* (non Milne-Edwards, 1840) Miers, 1877, *Proc. Zool. Soc. London*, ann. 1877, *p.* 670.
> *Ligyda exotica* Richardson, 1905, *Bull.* 54, *U. S. Nat. Mus.*, *p.* 676, *figs.* 716–718; Van Name, 1918, *Bull. Amer. Mus. Nat. Hist.*, XLIII, *p.* 72, *figs.* 27–30.
> See Van Name, 1918, for synonyms.

This species is found on the shores of most tropical regions of both hemi-

spheres. Richardson (1902) points out that the descriptions of the specimens from "Cayenne" doubtfully assigned by Miers, 1877, to *L. baudiniana*, agree somewhat better with the present species. In a later work (1905) however, she omits Cayenne from the localities given for *L. exotica*, though she credits *L. baudiniana* to that locality. It is likely that both species occur in Guiana.

Ligyda baudiniana (Milne-Edwards), 1840.

> *Ligia baudiniana* Milne-Edwards, 1840, *Hist. Nat. Crust.*, III, *p.* 155.
> *Ligia gracilis* Moore, 1902, *Bull. U. S. Comm. Fish and Fisheries*, XX, pt. 2, *p.* 175, *pl.* XI, *figs.* 7–12.
> *Ligyda baudiniana* Richardson, 1905, *Bull.* 54, *U. S. Nat. Mus.*, *p.* 678, *figs.* 719–723.
> See Richardson, 1905, for synonyms.

Locality.—Cayenne, Miers, 1877 (?); Richardson, 1905. See remarks under *L. exotica*.

Ligyda cajennensis (Koch), 1847.

> *Ligia cajennensis* Koch, 1847, *Syst. Myriapod.*, *p.* 212, *pl.* IX, *fig.* 102; Budde-Lund, 1885, *Crust. Isop. Terr.*, *p.* 271; Jackson, 1922, *Proc. Zool. Soc. London*, 1922, *pp.* 698, 701.
> *Ligia cayennensis* Stuxberg, 1875, *Öfvers. k. svensk. Vetensk.-Ak. Forh.*, XXXII, No. 2, *p.* 43.

Locality.—Cayenne.

Of the fourteen species of isopods collected at Kartabo, six are aquatic and eight are terrestrial forms. Although the water of the rivers is entirely fresh at that point, the close relationship of the aquatic forms to marine species is worthy of note. *Nototanais beebei* fits fairly well into a genus of the sub-antarctic seas, several species having been described from that region of the world, of which *N. dimorphus* (Beddard), 1886, (syns. *Paratanais d.* Beddard 1886, Rep. Voy. *Challenger*, Zool., XVII, p. 130, Pl. XVII, figs. 1–8; *Nototanais australis* Richardson, Exped. Ant. Franç., 1903–1905, Isopodes, Mém. 2, p. 1 fig. 1; *Nototanais d.* Vanhoeffen, Deutsch. Südpol.-Exped., XV, p. 470) seems to be the closest to *N. beebei*. It was originally collected by the *Challenger* Expedition off Kerguelen Island in rather deep water, and has been since found in other sub-antarctic localities.

Excorallana and *Livoneca* are genera whose species are mainly marine; they are predaceous forms that attach themselves to fishes, which has no doubt contributed toward the extension into fresh water of certain of their species. *Telotha* is represented by two species in South American rivers, but is very closely related to, and perhaps derived from the same immediate ancestors as *Cymothoa*, widely distributed in the sea. This genus is likewise parasitic on fishes. The remaining aquatic genus, *Probopyrus*, is also unquestionably one of marine origin, some of its species being parasites on strictly marine species of shrimps.

Moreover one of the terrestrial forms (*Ligyda*) belongs to a genus whose most familiar species are inhabitants of the sea coasts, living on wet rocks piles of wharves, etc. at the water's edge, but in this case we may feel uncertain as to whether such littoral habits are not merely a recent acquirement of certain species.

DESCRIPTIONS OF SPECIES

Suborder CHELIFERA

Family TANAIDAE

Nototanais beebei, sp. nov.

(Plate VII, figs. 1–2)

Five specimens of this species were collected; three of them are in a very poor condition for study, as they are rolled up in a small circle (the dorsal surface outside), the large chelae being extended out at right angles, showing a degree of mobility in these limbs which one would hardly expect from their compact articulation. The other two specimens are straightened out, or nearly so, and the following description and figures have been based chiefly on these two. All

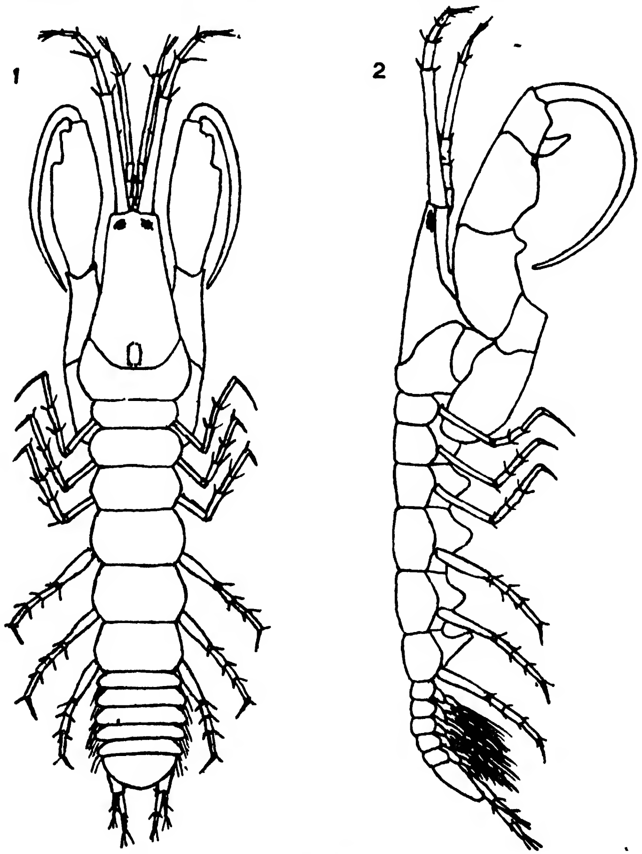

Plate VII —1–2, *Nototanais beebei*, sp. nov. × about 40.

the five specimens are apparently males, and we may expect the females to have smaller and simpler chelae and probably but three segments in the first antennae.

Body elongate; the average width is contained six or seven times in the length. Back flattened, the segments being only slightly arched from side to side. All the segments are free and separately movable except the first thoracic segment, which is immovably united with the head. The specimens do not vary greatly in size; the largest do not much exceed 2 mm. in length. The alcoholic specimens are of the usual yellowish color.

Head very elongate (over one-quarter of the total body length), its posterior end wide and rounded, and deeply set back into the first thoracic segment; its sides converge gradually toward the rather narrow front end, which is truncate and has a slight median projection. Eyes represented by two pigmented areas on the upper surface at the extreme front end of the head. First antennae stout, of five segments; the basal one being very long, the terminal one minute; second antennae smaller and shorter, also of five segments, the three first short, the fourth very long; the second segment bearing a spine or scale on the median side at its distal end. The upper surface of the head is fairly smooth and even except for an oval depression on the median line near the posterior border.

The first thoracic segment is the widest part of the body and bears the enormous chelae which terminate in a long recurved scythe-like dactylus. The lower border of these chelae presents several teeth or projections, notably a long, triangular downwardly and distally directed one near the end of the propodus. Their superior border is evenly curved.

In strong contrast to their flattened dorsal surfaces, the thoracic segments (especially toward the posterior end of the body) have their median ventral region produced downward into a keel-like projection. On the seventh segment this is long and more or less terete, and has an obliquely forward and downward direction. Except the first, the thoracic segments are of nearly uniform width, though varying greatly in length, the fifth, sixth and seventh being the longest; the abdominal segments are equally wide but all very short except the telson, which is broadly rounded behind. The thoracic legs are long, weak and slender; the first pair behind the chelae have the terminal claw much longer than the others, and the last three legs are somewhat stouter than those in front. The pleopoda are developed on all the five first segments of the abdomen. They are short, and bear an abundance of long swimming hairs. The uropoda each consist of a short basal segment which reaches a little beyond the telson and two terete branches, the inner of which is longer and stouter, though so far as I could demonstrate, they both consist of two segments.

The collection comprises five specimens, (original collector's number 22497), from Kartabo, British Guiana. These were all taken from the stomach of a six-inch cat-fish, *Pimelodus clarias* (Bloch). Its nearest ally seems to be *N. dimorphus* (Beddard), 1886, as noted in the introductory part of this article. The species is named for William Beebe, Director of the Tropical Research Station.

Suborder FLABELLIFERA

Family EXCORALLANIDAE

Excorallana berbicensis Boone, 1918.

Excorallana berbicensis Boone, 1918, *Proc. U. S. Nat Mus.*, LIV, *p.* 594, *pl.* XCII, *fig.* 1.

(Plate VIII, figs. 3–8 incl.)

The collection contains two specimens, a female 7.8 mm. long and a male 6 mm. long, which I refer to this species. The original description was based on two specimens, apparently both females. The discovery of the male shows that it is a species very closely related to *E. tricornis* (Hansen), 1890, known from the West Indian region, and represented, according to Richardson, 1905, p. 141, by a subspecies (*occidentalis*) in the Gulf of California. From that species it is however at once distinguished by the absence of incisions in the sides of the tapering part of the telson, and in the female apparently also by the entirely smooth upper surface of the head. In the male the head bears an anterior median process or prominent tubercle, and a pair of somewhat smaller ones between the eyes as in *E. tricornis*, and the surface of the head within the triangle thus formed is depressed or concave.

Body rather elongate, more so in the female, where the greatest width is contained over three times in the length, than in the male, where it is contained about two and three-quarters times. In the male specimen the first thoracic segment is considerably longer, and the fifth, sixth, and seventh considerably shorter than the rest; in the female not only are the individual thoracic segments, except the first, proportionately longer on the median line and narrower, but only the seventh is conspicuously shorter. The first three have the posterior lateral angles rounded off; the last four have them sharp and extended backward to an increasing degree as the rear end is approached. Articulation firm; body surface for the most part hard and smooth, except for a minute irregular pitting visible only on considerable magnification. The last two or three thoracic and the third and fourth abdominal segments bear a row of small tubercles near the posterior edge, also a few short backwardly directed hairs. The fifth abdominal segment bears four tubercles along the posterior border; the telson has two pairs of small ones on the anterior part (two near the middle and two near the bases of the uropoda). These tubercles, which are all small, are more conspicuous in the male specimen, though present in both sexes. Legs of the first three pairs stout and provided with prehensile claws. The merus of the first pair bears on its lower outer aspect a row of five blunt tubercles. On the succeeding pair there are four of these tubercles (the middle one of the row being wanting); on the third pair but three. This is the condition in both the male and female specimens. The fourth to seventh legs are elongate, slender and not prehensile.

The head is narrow and rounded in front except for a small median process. The eyes are large with about eight horizontal rows of ocelli, with eight ocelli in the longest rows. The first antennae meet at the median line and form the extreme front outline of the head; they have ten articles in the flagellum, the first being very short and the second (in the female specimen, also the third)

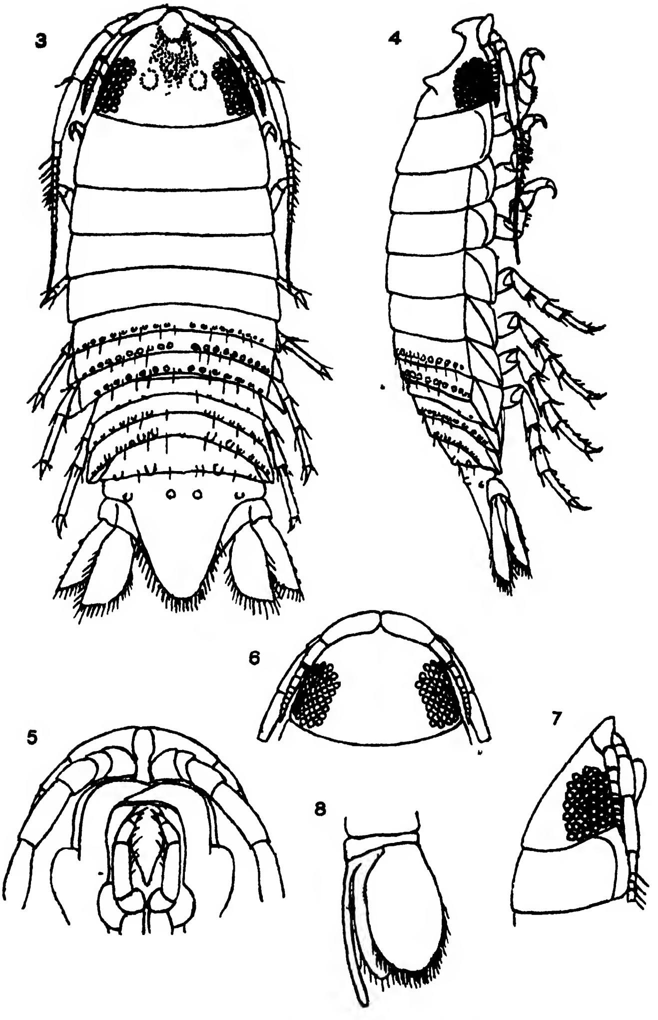

Plate VIII—*Excorallana berbicensis* Boone, 1918, 3, and 4, male × 13 5, 5, ventral aspect of head of female × 19, 6 and 7, dorsal and lateral aspects of head of female × 14, 8, second abdominal appendage of male × 22

article being somewhat elongated. They reach, when drawn back, a little way beyond the rear border of the head. The second antennae have the three basal joints short and the fourth and fifth long, the flagellum has eighteen to twenty articles of which the first is more elongated than the succeeding ones; they reach, when well drawn back, along the fourth thoracic segment to about its middle. They are a little slenderer in the female than in the male.

The abdomen is wide; its first segment is practically covered by the seventh thoracic; the fifth has its lateral ends covered by the backwardly produced ends of the fourth. The second pleopoda of the male bear a slender blunt-ended styloid process longer than the foliaceous parts of the appendage. The terminal half of the telson and the branches of the uropoda, except the outer edge of the outer branch, are fringed with hairs. The inner branches are wide; the outer narrow, and both have the ends obliquely truncated.

The two specimens described above are both inferior in size to Miss Boone's type from the Rio Berbice, British Guiana, which measured 13 mm. by 4 mm. They were both collected at Kartabo, British Guiana, by William Beebe (collector's number of male 221104, of female 22364). The male was taken from the gills and the female from the pectoral fin of different specimens of *Lycengraulis grossideus* (Cuvier).

Family CYMOTHOIDAE

Livoneca symmetrica, sp. nov.

(Plate IX–X, figs. 9–14 incl.)

The six adult specimens in the collection range from 20.6 to 17 mm. long. All but two are females with large marsupial plates forming a large well distended marsupium. The two others, though lacking the marsupial plates, are quite similar to the rest in other respects and are apparently also females. The body surface is very slightly rough, pale yellowish in color, and bears minute scattered spots of blackish pigment.

The head in a dorsal view is gently rounded in front and behind with straight sides converging toward the front. It is scarcely at all set back into the thorax, though the first segment of the latter is produced forward a little way into a small lobe of rounded-triangular shape at each of the forward corners. The eyes are rounded-oblong in outline, of fair size, and well pigmented. The front of the head is somewhat bent down over the bases of the antennae. The antennae of the two sides arise well apart. The first pair is the stoutest, and is eight-jointed. The second pair is more slender and a little longer and is nine-jointed. The form of the thoracic segments and their epimera are sufficiently shown in the figures here given. The legs are fairly long, but the thighs are not expanded or provided with a keel. The dactyli are strongly hooked and increase in length from the first to the sixth pair; those of the seventh pair are smaller even than those of the first. The abdomen is wide and slightly diminishes in width toward the rear. It is deeply set into the thorax, and the lateral ends of all its segments except the first (which, however, is of the full width), are bent backward and pointed. The telson is wide and strongly arched, and has the posterior outline slightly produced, forming an obtuse median angle. The

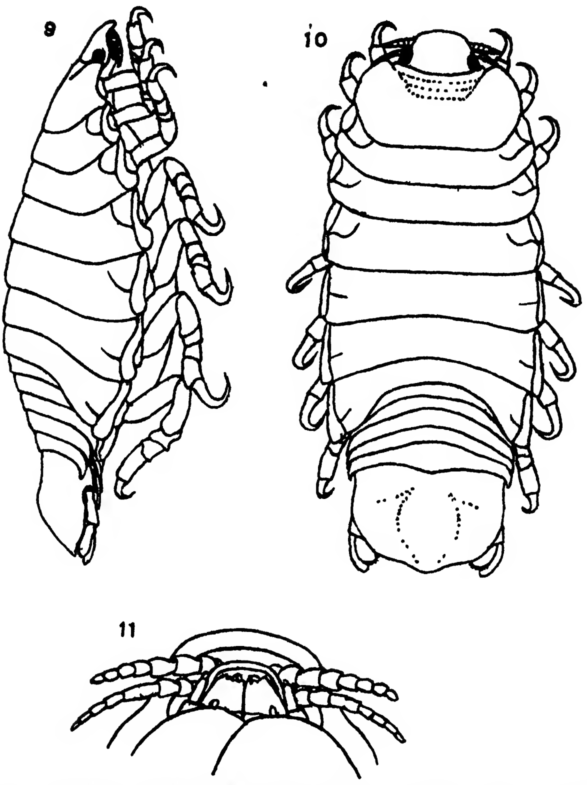

Plate IX.—*Livoneca symmetrica*, sp. nov.: 9 and 10, female × 4; 11, ventral aspect of of head same × 12.

uropoda reach to or slightly beyond its end; the outer branch is slightly falcate, the inner is shorter and oval. Both are rounded at the end.

A larval individual (fig. 12) from the marsupium of one of the adults is about 3.6 mm. long and differs much from the adult, not only in the proportionately larger and longer abdomen and telson, but in the very much greater length of the head, which is produced in triangular form anterior to the eyes to a remarkable extent. The upper parts bear more blackish pigmentation than the adults have; this is distributed chiefly in rather narrow median and lateral stripes (one on each side) and in thin, broken transverse lines on the thoracic and abdominal segments. The eyes are larger and more deeply pigmented than in the adult, and the antennae, though having the same number of segments, are proportionately longer. The seventh pair of legs are not yet developed and the corresponding thoracic segment is very short and small. The other legs are long and all have strong hooked dactyli, those of the anterior legs being the largest. The propodus of all the legs is somewhat widened and flattened, but is without spines; the dactyli are not denticulated.

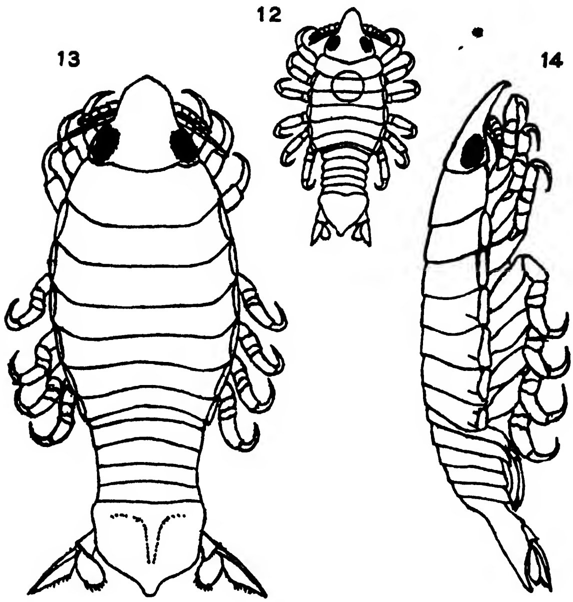

Plate X.—*Livoneca symmetrica*, sp nov. Young stages, 12, larval individual 3.6 mm long from marsupium of adult; 13 and 14, young individual 8 5 mm. long.

Schioedte and Meinert (1884) include in the genus *Livoneca* species (*L. indica* and *L. sinuata*) having the propodus of the legs of the larva without spines as in this form, in most species of *Livoneca*, when the larva is known, the propodus bears a row of spines. I am inclined to suspect that this is a character upon which not only the species of *Livoneca* but those placed by the above authors in various allied genera might well be rearranged, but this must await a knowledge of the larval forms of more members of this group. The fact that information regarding this character is available in the case of so few species makes it seem premature to place this species elsewhere than in *Livoneca*, though it is far from being a typical example of that genus.

The young individuals of this stage all bear a foetal character in the form of a definitely circumscribed circular swelling or raised area, whose surface is finely granular when dry, on the median part of the back. Its center is on the second thoracic segment, but it encroaches also on the first and third segments. Another foetal character is that the ventral region of the body is still distended by a considerable quantity of yolk.

What I believe to be a slightly later stage of this same species is represented by an individual about 4.2 mm. long, taken from a young cichlid fish (*Cichla ocellaris*). The body is more flattened than in the stage just described, the yolk has disappeared and the seventh legs are present though not fully developed. In the specimen shown in figs. 13 and 14 and which is 8.5 mm.

long, representing, I believe, still another stage in the development of this species, the seventh legs are well developed.

The specimens of this species bear the following collector's numbers and data:

221077—Female with empty marsupium from the gills of *Myloplus rubripennis*, Sept. 4, 1922. Type.

22440—Female with 28 large larvae in marsupium from Perai fish, *Serrasalmo rhombeus* Linnaeus, July 22, 1922.

2412—Four adults (two with marsupium which in one case contained large larvae) from giant catfish or Lau-lau (*Brachyplatystoma* sp.), March 4, 1924.

201529—Two larvae like fig. 12, probably from the marsupium of an adult.

221007—Young individual, shown in figs. 13 and 14, from the scales of the catfish *Hemidorus carinatus* (Linnaeus).

24485—Very young individual 4.2 mm. long taken from a young Lucananni fish, *Cichla ocellaris* Bloch and Schneider, May 4, 1924.

Livoneca guianensis, sp. nov.

(Plates XI–XII, figs. 15–18 incl.)

The two adult specimens that were collected are females 17.7 mm. and 26 mm. long respectively, each having a well developed marsupium which contains embryos in the smaller specimen.

The body is of elongate obovate outline, slightly assymetrical, widest at the third thoracic segment, behind which it tapers in width regularly to the end of the thorax. The head is but little set back into the thorax except that the first segment of the latter is extended forward in a small round-triangular lobe at each anterior corner. The sides of the head converge forward; the front is obtusely triangular, with a small rounded-triangular median point or process. The abdomen is of almost uniform width, not much less than that of the end of the thorax, and is but little set forward into the latter. The body surface is smooth and highly polished, of the usual yellow color without pigment except a very few blackish dots distributed chiefly along the median dorsal line and near the rear borders of the segments.

The upper surface of the head is convex and the anterior tip is considerably bent down. The eyes are small, rounded and situated on the sides of the head; they are well pigmented. The first antennae arise well apart. They are very short and stout, with eight joints, of which the second is considerably the longest, but not swollen. The joints are not compressed. The second antennae are slender and have but seven joints which are somewhat compressed. The first two are wide but very short, the others are so elongate that this pair of antennae slightly exceeds the first pair in length.

The first segment of the thorax is wide and moderately long; the second and third (the latter the widest of all, as above stated) are short; the succeeding ones are all rather long. They have rather narrow but thick epimera, which except in the case of the seventh, fail by a greater or less interval to reach all the way along the lateral end of the segment. The legs are only moderately

15 16 17

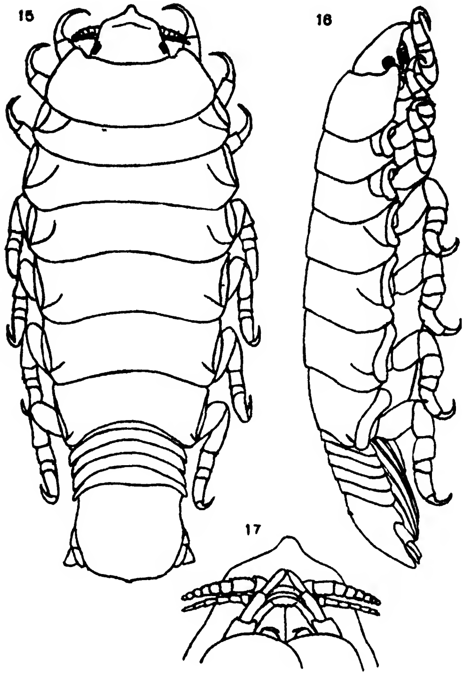

Plate XI.— *Livoneca guianensis*, sp. nov.; 15 and 16, female × 4.6; 17, ventral aspect of head of same, × about 10.

stout, but considerably compressed laterally, so that they appear much stouter in a side view. The dactyli are sharp and hooked, and vary comparatively little in length; those of the first pair are, however, the longest, although the last pair of legs exceeds the others in total length.

The abdominal segments have the lateral ends obliquely truncated and the posterior corners rounded off. The telson is about as wide as the rest of the abdomen and about as long as it is wide. It narrows but little toward the rear end, which is rounded off, but bent down so as to appear almost truncated in a dorsal view of the animal.

The uropoda are shorter than the telson. The outer branch is wide and somewhat obliquely truncated at the end; the inner branch is oval.

The smaller of the two (the type and subject of the figures) was collected by William Beebe at Kartabo, British Guiana, July 7, 1920.

The larger one (original number 201518) also from Kartabo, was taken from the gills of *Leporinus fasciatus* (Bloch). It differs little from the other except in size and in having the last thoracic segment somewhat shorter, the abdomen being more set back into it.

A third individual, only 12 mm. long and not over 3.9 mm. wide at the third

thoracic segment (thus proportionally narrower than the larger ones) is evidently immature. It was taken from the gills of a fish, *Pimelodus clarias* (Bloch), which had been eaten by a snakebird, June 3, 1924. (Collector's number 24818).

The collection contains also a small larval isopod (collector's number 2412) having the seventh thoracic legs still undeveloped, which was taken from the Giant Catfish (*Brachyplatystoma* sp.) March 4, 1924. I give a figure (fig. 18)

18

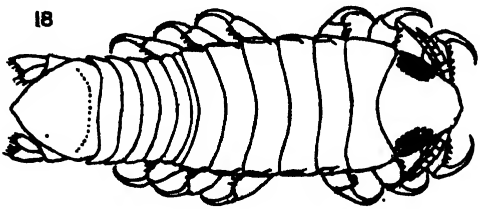

Plate XII.—18, Larval isopod, 2.4 mm. long; possibly young of *Livoneca guianensis*, sp. nov.

of this specimen here as possibly belonging to this species, but without committing myself to that opinion. Embryos taken from the marsupium of the type of the species just described (*Livoneca guianensis*), were in too early a stage to give evidence either for or against this view.

The specimen is only 2.4 mm. long and of decidedly flattened form. The anterior end of the head bends down slightly in front of the antennae. The eyes are large and have about 30 ocelli. The first antennae arise well apart; they are stout and do not much more than reach the rear border of the head. They apparently have 8 segments; the second pair are somewhat longer and slenderer and have 9 or 10 segments.

The six pairs of legs are rather long and all terminate in large curved dactyli which do not have their concave margins denticulated. The anterior edge of the propodus (the limb being laterally extended) bears a row of five or six short spines. This is true of all the legs. The propodus is moreover much widened and flattened, especially in the case of the first three pairs.

The abdomen is somewhat narrower than the thorax, but not abruptly so. The telson has an outline approaching an equilateral triangle with the lateral borders convex; its anterior margin is raised or thickened. The branches of the uropoda do not exceed the telson, their outer branches are truncated obliquely; the inner branches are smaller and of ovate outline. Both branches are fringed with a few short stout hairs.

Telotha henselii (von Martens), 1869.

Cymothoa henselii v. Martens, 1869, *Arch. Naturg.*, XXXV, part 1, *p.* 33, *pl.* II, *fig.* 6.

Telotha henselii Schioedte and Meinert, 1884, *Naturh. Tidsskr.* (3) XIV, *p.* 287, *pl.* X, *figs.* 11, 12; Richardson, 1904, *Proc. U. S. Nat. Mus.*, XXVII, *p.* 23; Niewstrasz, 1915, *Zool. Meded. Rijks. Mus. Leyden*, Ann. 1915, *p.* 95.

(Plate XIII, figs. 19–23 incl.)

The Kartabo collection contains nine specimens which appear to be refer-

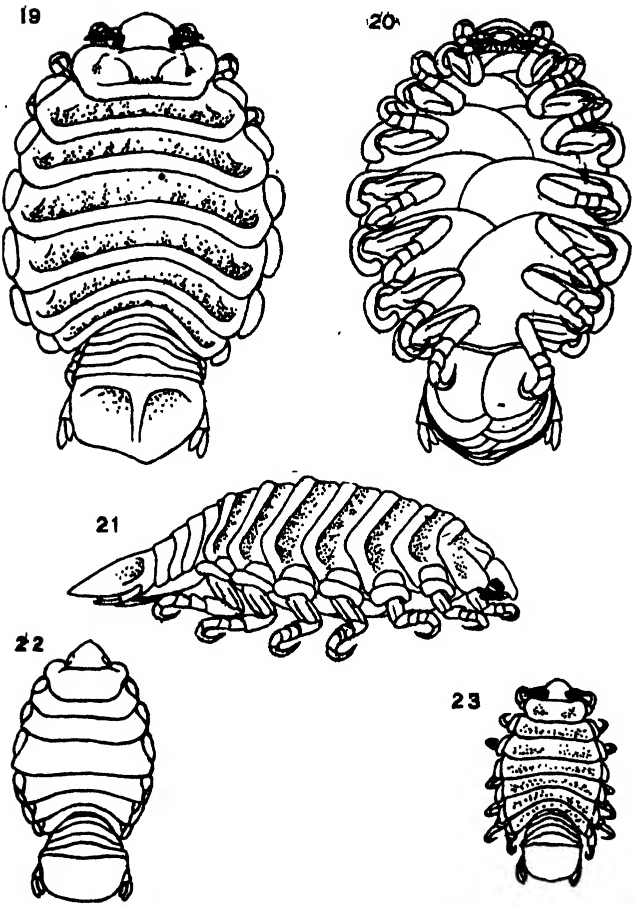

Plate XIII.—*Telotha henselii* (von Martens) 1869; 19 to 21, female (16 mm. long) 3.8; 22, very old individual (26 mm. long) × 1.4; 23, young individual (6.6 mm. long) × 4.

able to this species; they are of various ages ranging from a very large and old individual 26 mm. long down to immature ones little over 6 mm. long; these, however, have already reached a stage differing comparatively little from the adult (fig. 23). The largest individual has no marsupium but is apparently a female. If so, there is no adult male in the collection, neither have other authors given a description of it. The older specimens have the body surface practically devoid of any pigment (except in the eyes). Younger specimens have scattered, minute, blackish dots, chiefly near the lateral ends of the segments and along the anterior border of the telson, also a few along the median region of the back. The largest individual mentioned above, and shown in outline

in fig. 22, presents several small abnormalities, notably the exceptional length of the first and fourth thoracic segments (the second and third being unusually short), the tapering rather than oval outline of the anterior part of the body when seen in a dorsal view and the unusual length and more pointed outline of the anterior part of the head. The next largest individual, a female 16 mm. long by 10 mm. wide, having a well developed marsupium, has been chosen for the principal illustrations (figs. 19 to 21), as being a more typical specimen.

The body is quite broadly oval, rather highly arched in old specimens, but flatter in young ones. The head is wider than long and of triangular outline, rounded in front, its anterior margin is considerably bent downward. The eyes are oblong and fairly well pigmented; the first antennae, which arise a little distance apart, are stout, but little compressed in cross section, and have only eight segments (according to Schioedte and Meinert they have nine). The second antennae usually exceed the first pair a little in length, they are much slenderer and have nine segments. The head is not deeply set back into the thorax.

The thoracic segments have the posterior border thickened and very prominent, in front of this the surface of the segment is more or less irregularly roughened and sculptured. The epimera are large and thick, especially in the middle region of the body, and are surmounted by large convex bosses on the lateral ends of the main portion of the segments.

The legs are strong and of moderate length; their length increases toward the rear of the body. The dactyli are large and strongly hooked. The propodus of all the legs is curved, increasing the hook-like prehensile character of the limb; in the case of the three anterior legs that joint is somewhat flattened, though not much widened. The thighs are not compressed; their external aspect (the inferior aspect when the legs are drawn together under the body) is flattened or even slightly concaved. There is never more than a very slightly prominent ridge or keel.

The abdomen is rather narrow in front, moderately immersed in the thorax, and widens behind. The telson is very broad and has the posterior margin normally very gently curved, but in the individual shown in figs. 19 to 21, it is unevenly worn off, as are also some of the pleopoda, evidently by pressure and friction from some part of the host. The telson has the anterior margin thickened and the dorsal surface more or less arched or convex; in the older specimens there is a poorly defined median ridge or keel each side of which the surface is minutely pitted and roughened. The uropoda and their branches are small and short; in adults they do not reach much beyond the end of the telson.

Of the nine specimens from Kartabo, six, including all the larger ones, were together in a container bearing the collector's number 2412 and were taken from a giant catfish (*Brachyplatystoma* sp.), native name Lau-lau, March 4th, 1924.

Three small specimens have the collector's number 24757 and were taken from another catfish, *Pimelodus clarias* (Bloch), May 28, 1924.

The specimens of von Martens, five in number, were from the gills of a cichlid fish (*Geophagus* sp.) taken at Porto Alegre, Rio Grande del Sul, Brazil, and were also examined by Schioedte and Meinert. They are in the collection of the Berlin Museum. The latter authors mention also four other specimens from "somewhere in Brazil."

The differences in the outline of the individuals figured by von Martens and Schioedte and Meinert, as well as several small discrepancies between the figures of the latter and their descriptions, indicate that the specimens of these authors, just as in the case of those in the present collection, show considerable variations in many characters, and were I to regard the present specimens as constituting another species, it would be hard to find characters on which the distinction could be based. One of the most definite would seem to be their 8-jointed instead of 9-jointed first antennae, but I do not feel disposed to rely on this as a specific character, especially as some of the Kartabo specimens have their first antennae ending so bluntly that one might easily be led to assume that they had lost a segment at the tip.

The notes on the Kartabo specimens do not state on what part of the fish they were found, but from the nearly complete absence of pigment they seem most likely to have lived in the gill cavity as was the case with von Marten's examples.

Suborder Epicaridea

Family BOPYRIDAE

Probopyrus bithynis Richardson, 1904.

Probopyrus bithynis Richardson, 1904, *Proc. U. S. Nat. Mus.*, XXVII, *p.* 68, *figs.* 47–51; 1905, *Bull.* No. 54, *U. S. Nat. Mus.*, *p.* 557, *figs.* 606–611; Pearse, 1911, *Rep. Michigan Acad. Sci.*, XIII, *pp.* 108, 109; 1915, *Proc. U. S. Nat. Mus.*, XLIX, *p.* 550.

(Plates XIV–XV, figs. 24–26 incl.)

A considerable series of specimens from Kartabo shows that this species is a common parasite of the shrimp *Macrobrachium lamarrei* (Milne-Edwards), 1837. It has been previously recorded by Richardson (1904, 1905) from New

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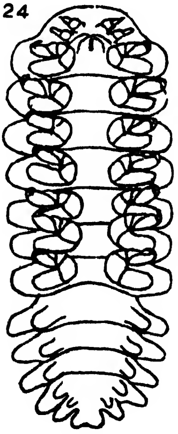

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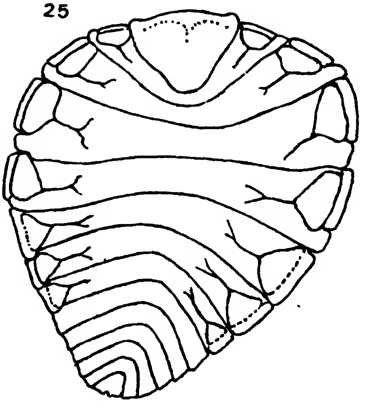

Plate XIV.—*Probopyrus bithynis* Richardson, 1904; 24, male, ventral aspect, × 28; 25, female, dorsal aspect. × 5.

Orleans, Louisiana, on *M. ohionis* (Smith), and Bluefields, Nicaragua, on *M. acanthurum* (Wiegmann); by Pearse (1911, 1915) from the State of Vera Cruz, Mexico and from Santa Marta, Colombia, on *M. olfersii*, and has been so well described and figured by Richardson that its characters need not be considered in much detail here. The present specimens infest shrimps of from nearly 50 to somewhat over 80 mm. in length (inclusive of the rostrum). No infested examples were among the other specimens of this shrimp of lesser or greater length that were collected, indicating that there is a particular and somewhat limited age or size favorable for becoming parasitized. Except in one case the parasites are all adult; in almost all cases they have the marsupium well distended with eggs, and usually one of the minute males may be found clinging to the ventral side of the abdomen of the female, between and partly covered by the pleopoda. The single exception is a small very poorly preserved and evidently immature parasite in the smallest of the infested shrimps, an individual a little under 50 mm. long.

The female parasite lies in the branchial chamber of the shrimp, with the head directed posteriorly and usually somewhat dorsally (relative to the host's

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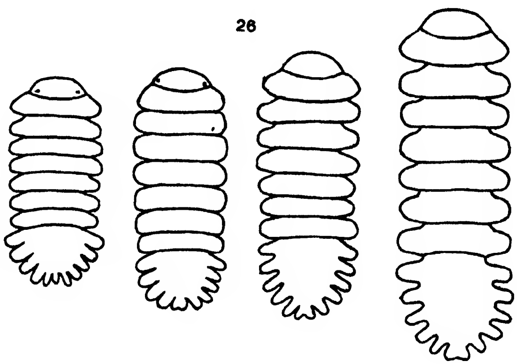

Plate XV.—26, *Probopyrus bithynis* Richardson, 1904. Outlines of segments of four male individuals to show variation in size and form. × 16.

body) and with the ventral aspect outward and the dorsal aspect, which is perfectly flat, against the gills of the host. The body of the female is asymmetrical to a varying but usually considerable degree; the convexity of the long. axis is toward the ventral side of the host, and consequently toward the left if the parasite was borne in the left branchial chamber of the host and toward the right in the opposite case. No shrimps were found infested on both sides. The female is without eyes, and measures in greatest length 10 to 11 mm. in the case of the largest individuals, which are naturally to be found in the larger and presumably older shrimps. The marsupial plates, which are far too short to completely cover the immense mass of eggs that the animal bears, are more or less pigmented with conspicuous areas of blackish pigment, some of which also occurs on the lateral parts of the segments of the shorter side of the body

on both ventral and dorsal sides of the thorax on the dorsal side, especially along the lines of articulation between these segments. The amount and intensity of the pigment is variable; it is usually quite conspicuous, even through the carapace of the host, which of course exhibits a large localized swelling over the location of the parasite. The head may or may not have the anterior lateral corners produced into more or less distinct lobes. Each of the pleopoda consists of a short basal portion bearing two broad leaf-like smooth-edged branches. There are five pairs, decreasing in size from the first to the fifth segment of the abdomen. Uropoda are wanting.

The males vary in length from 1.7 mm. to about 3 mm., this difference being due in part to actual individual variation, but still more largely to the state of contraction of the body muscles, the body being very soft. This is clearly shown in the outlines of four individuals shown in Fig. 26, which also brings out the fact that the degree of constriction between segments is largely a matter of the degree of contraction and cannot be relied on as a specific character.

The body of the male is of oblong outline, moderately arched, with the thoracic segments all distinct and the abdominal segments all fused into a somewhat semicircular flattened mass with eleven rounded lobes around the margin. Ten of these represent the lateral ends of the abdominal segments; the median one, which may be longer or shorter than the adjacent lobes and is usually more or less emarginate or partially cleft into two, represents the telson. The head is rather short and wide and bears two minute pigment spots (sometimes not discernible) representing eyes. The mouth parts form a projecting mass on the lower side of the head, the two pairs of antennae are short and composed of a short, swollen basal part and a slightly longer abruptly narrower portion, on the extreme tip of which there are, on the first pair only, one or two very minute articles, but owing to the soft character of the structures and the indistinctness of the articulations the number of joints was not satisfactorily determined. The thoracic legs are all well developed and bear small but sharp and strongly hooked dactyli; the pleopoda are represented by five pairs of small rounded lobes or projections. No uropoda are present.

Twenty-nine parasitized shrimps of the above species were collected, each bearing a female to which a male is usually attached. (Original numbers 20903, 201532 and 201556, the last is dated 3-9-1919).

P. floridensis Richardson, 1904, p. 70, figs. 52–55; 1905, p. 555, figs. 602–605, from the St. John's River, and Miami, Florida, parasitic on *Palaemonetes exilipes*, is an allied species though apparently distinguishable by the somewhat rounded ends of the abdominal segments in the female, those of *P. bithynis* being squarely cut off. Another evidently closely related form is *P. pandalicola* (Packard), 1879 (see Richardson, 1905, p. 554, figs. 599–601) recorded from various points on the American coast from New Hampshire to Florida and Mississippi, parasitic on *Palaemonetes vulgaris* (Say) or allied species. This appears to be distinguished from *P. bithynis* chiefly by having the posterior prolongations of the first pair of marsupial plates distinctly hooked, and the lobes representing the fifth abdominal segment fused with the median one representing the telson.

P. panamensis Richardson, 1912 (Proc. U. S. Nat. Mus., XLII, p. 523, figs. 5–8) from the Canal Zone, Panama, parasitic in *Macrobrachium acanthurum*,

is still another closely allied form, distinguished by having the telson of the female notched (which, however, is often the case in the present species), and by having only the two last abdominal segments of the male fused into a distinctly separated piece.

Suborder ONISCOIDEA

Family ONISCIDAE

Subfamily EUBELINAE

Ethelum americanum (Dollfus), 1896.

Mesarmadillo americanus Dollfus, 1896, *Proc. Zool. Soc. London*, ann. 1896, *pp.* 397–398, Richardson, 1901, *Proc. U. S. Nat. Mus.*, XXIII, *p.* 573.

Ethelum americanum Budde-Lund, 1899, *Rev. Crust. Isopod. Terrest.*, *p.* 24; 1899, *Entomol. Meddel.*, (2) 1, Pt. 2, *p.* 90; Richardson, 1905, *Bull.* 54, *U. S. Nat. Mus. p.* 589, *figs.* 649, 650 (copied from Budde-Lund and Dollfus respectively); Pearse, 1917, *Occ. Papers Mus. Zool. Univ. Michigan*, No. 46, *p.* 1.

(Plate XVI, figs. 27–36 incl.)

I have little hesitation in referring the three small specimens listed below to the present species in spite of two or three discrepancies.

The largest female would measure, if straightened out, a trifle over 6 mm. long, the only male specimen scarcely 5 mm. long. The color is grayish brown above, with small light yellowish markings, the uropoda reddish yellow, and the legs and under parts yellowish.

The description given by Dollfus and quoted in Richardson (1905) is excellent for a brief diagnosis, but its shortness makes the mention of some other details desirable. The body is convex, and not very wide, with nearly vertical epimera except on the abdomen, where they bend or flare outward a little. Surface smooth except for a slight individual convexity of each segment, and a slight, scabrous pubescence; pubescence is more pronounced on the antennae and limbs. As shown in Dollfus' figure the epistome is continuous with the forehead in the middle, but ends in a small rounded slightly projecting lobe under each eye, separated from the forehead by an impressed line or groove. A branch of this groove (not shown in Dollfus' figure) runs up on the forehead a little way, along the inner side of the eye. Ocelli about 13 in the smaller specimens, the largest female has a few more.

The first thoracic segment has a slightly projecting lateral border which is wide (especially toward the front) in a lateral view and is separated from the body of the segment by a very deep furrow that curves sharply upward as the head is approached. It does not reach all the way to the posterior end of the segment. The posterior corner has a short V-shaped cleft to receive the second segment when the body rolls up. This cleft has the outer side (forming the posterior lateral angle of the segment) obliquely truncated; the inner side, which is very slightly longer, is sharply rounded off. The lateral ends of all the thoracic segments are somewhat rounded, the second, third and fourth more than those behind them. All the thoracic segments have the rear corners produced backward a little, but to a less extent as the posterior end is approached.

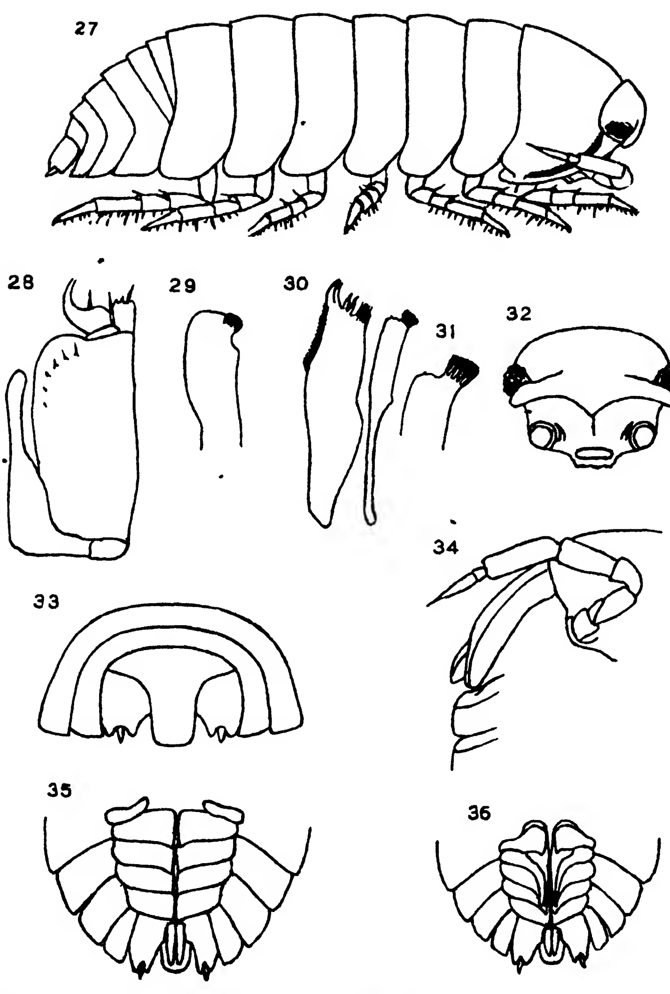

Plate XVI.—*Ethelum americanum* (Dollfus) 1896; 27, female × 13; 28, maxilliped × 52; 29, second maxilla × 52, 30, outer and inner divisions of first maxilla × 52; 31 tip of inner division of first maxilla × 52; 32, front of head × 16; 33, rear end of body × 18; 34, ventral aspect of anterior segments and antenna × 18; 35, ventral aspect of rear end of body of female × 13; 36, same of male × 11.5.

The legs are slender but fairly long, with only moderately developed spines. The basal segments of the uropoda are thick and convex, standing out more than the telson. The external branches are small and of tapering form, and are inserted in a deep notch in the extreme end of the basal segments.

The chief discrepancies between the above described specimens and previous descriptions are that I find no coxopodite process on the second thoracic segment, which merely has the anterior edge of the epimeral part thickened as though by an infolding of the edge (the third segment also shows this to a less degree); that the inner branch of the first maxilla bears five instead of four plumose tufts (verified on both right and left sides); and that the inner branches of the uropoda are longer than described, reaching nearly or quite to the end of the telson. I do not feel justified in assuming that the present specimens are a new species because of differences so small and so likely to be explainable by the difficulties of exact observation in the case of such a small form.

These specimens were collected by William Beebe at Kartabo under dead wood at the edge of the jungle, September 22, 1922. (Collector's number 221115). It has also been recorded from Dunoon, British Guiana, on trees among bromeliads, vines, etc., by Pearse, 1917. The species was described by Dollfus from St. Vincent, W. I.

Subfamily ONISCINAE

Leptotrichus pittieri Pearse, 1921.

Leptotrichus pittieri Pearse, 1921, *Proc. U. S Nat. Mus*, LIX, *p.* 460, *fig.* 1

(Plate XVII, figs. 37–42 incl.)

I feel little hesitation in referring the specimens here illustrated to this species, which was briefly described by Pearse, in spite of two small discrepancies that his figures show, the antero-lateral lobes of the head being somewhat more prominent and angular and the telson a little narrower in his figures than I find them to be in the Kartabo examples.

The body is rather broad and, as seen from above, of ovate outline, the head wide and short and set back nearly half its length into the thorax, and the abdomen rather small and tapering. It is of rather delicate structure, the segments and limbs being loosely articulated and the length to width ratio of the body varies very greatly with the degree of contraction of the muscles connecting the segments. The specimens in the collection range from about 3 mm. to 4.2 mm. long, the variation being due more to different conditions of contraction than to size. The specimen illustrated in figs. 37 and 38 has them considerably contracted and the segments drawn well together. It is possible that the females are somewhat wider-bodied than the males, but this is difficult to determine certainly in the varied states of contraction of the preserved specimens. The color is light yellowish or yellowish white, the body being unpigmented.

The most characteristic feature of the species is the one first mentioned in Pearse's short description and illustrated in one of his figures. This is the modification of the hairs or setae covering the body into minute, short, thick, often

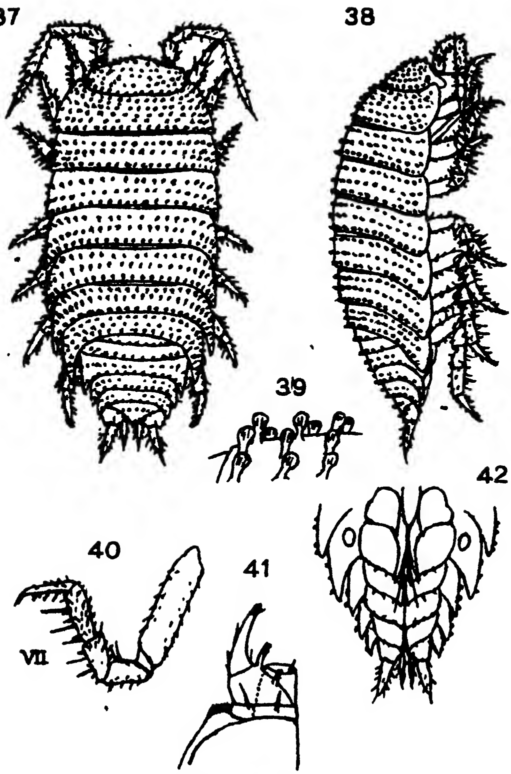

Plate XVII.—*Leptotrichus pittieri* Pearse, 1921; 37 and 38, female × 16; 39, modified setae on dorsal surface × 60; 40, seventh leg × 32; 41, tip, of maxilliped × 94; 42, lower side of abdomen of male, × 21.

distinctly club-shaped or capitate processes of a soft, flexible consistency (fig. 39). On the antennae, legs, pleopoda, etc., however, the setae retain their original hair-like character and intermediate conditions between ordinary hairs and the club-shaped structures may be observed on various parts of the body.

On the back these modified setae are arranged in fairly regular transverse rows, some thirty or more in a row in the wide parts of the body, and three rows on most of the thoracic segments, though there are four on the lateral parts of the second segment and more numerous rows on the first segment and head. The abdomen has one row on the first and second, two on the third, fourth and fifth segments. When these structures are rubbed off, which easily happens, the body is left quite smooth. The antennae are rather short and have the flagellum with two distinct articles, the first one rather short. The second article exhibits, however, a more or less noticeable joint a little beyond its middle, but this is apparently so firmly consolidated as to be immovable. Apparently we have in this species a form in which the flagellum, originally

composed of three articles, is becoming reduced to a two-segmented condition by the fusion of the two terminal articles. The eyes are very poorly developed and inconspicuous.

The first thoracic segment is the longest, the seventh the shortest. All except the first have the posterior angle extended back to a successively increasing extent. This angle is well rounded off in the first four thoracic segments, and not actually sharp in any of them. The third to fifth abdominal segments have the corresponding angles sharp and also well extended back. The legs are of moderate length, stout and well provided with spines and hairs. Sexual differences in them were not noted.

The telson is triangular, with slightly concave sides; the external branches of the uropoda are stout at the base, tapering rapidly to a point, and are of more or less terete section. The inner branches are somewhat shorter, as well as being inserted on the basal joint at a point farther forward, and are compressed so as to appear narrow in a dorsal but rather wide in a lateral view.

Three specimens were obtained at Kartabo from dead wood (Collector's number 22349). Another was obtained by sifting, and still another is without data. Their unpigmented body and rudimentary eyes show adaptation to a burrowing life.

Pearse described the species from a specimen found under a log at Maracay, Lake Valencia, Venezuela. He does not indicate that he had more than one specimen.

Circoniscus gaigei Pearse, 1917.

Circoniscus gaigei Pearse, 1917, *Occ. Papers Zool. Mus. Univ. Michigan,* No. 46, *p.* 4, *fig.* 2

(Plate XVIII, figs. 43–51 incl.)

The largest specimen of this species in the Kartabo collection is a male which, if it could be straightened out might measure nearly 16 mm. long; the largest female would probably measure about 13 mm. The ground color of the upper parts of the alcoholic specimens varies from rather dark grayish brown to pale brown with a grayish tinge. There are numerous very small somewhat irregular yellowish markings on the forehead and lateral parts of the back; the lower parts, limbs and antennae are unpigmented and of a uniform yellow color. Two of the females have marsupial plates but are not carrying young. The plates are rather small and do not overlap much along the median line.

Body highly arched, and fairly broad in spite of the lateral ends of the segments extending down almost vertically. An exception to this statement is that the first thoracic has the front part of the border narrowly rolled outward and that the ends of the third, fourth and fifth abdominal segments bend or flare outward a little. Articulation firm and compact. In a dorsal view the front of the body (including the front of the head) is rounded in a broader curve than the posterior end.

Body surface very smooth and even. No tuberculation. The surface is very thickly dotted with minute, scabrous punctae bearing very minute short hairs. On the antennae, legs, etc., there is a coarser and more conspicuous pubescence. Legs rather weak and slender, with rather weak but moderately numerous spines.

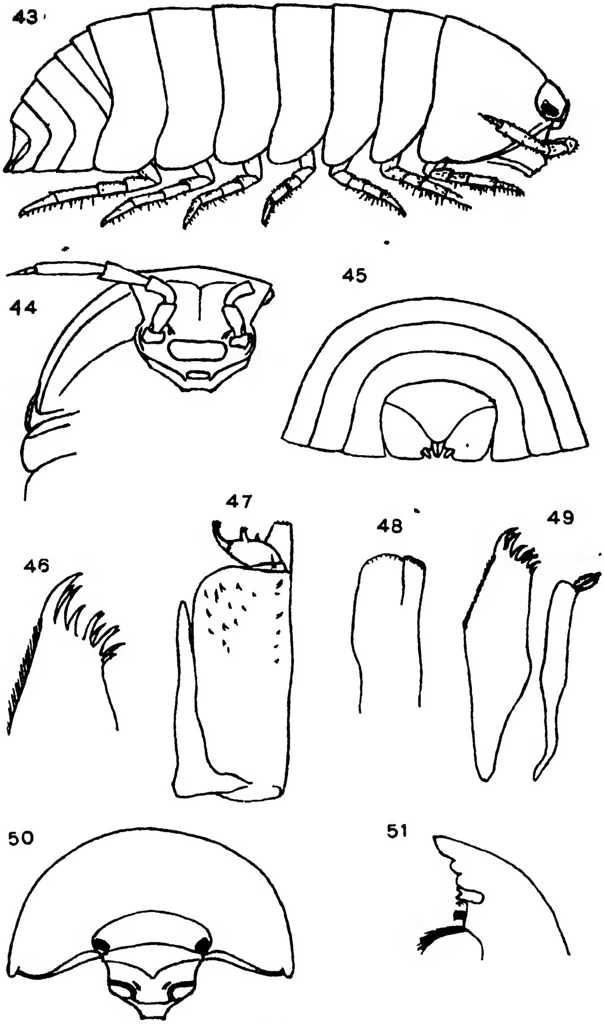

Plate XVIII.—*Circoniscus gaigei* Pearse, 1917; 43, female × 6 5; 44, ventral aspect of anterior segments × 8; 45, rear end of body × 8; 46, tip, of outer division of first maxilla × 40; 47, maxilliped × 28; 48, second maxilla × 28; 49, inner and outer divisions of first maxilla × 28; 50, front of head and first thoracic segment × 6; 51, tip of right mandible × 35.

Head rather narrow, forehead low, upper edge of the epistome arched, forming a projecting upturned border distinct all the way across the head. First antennae minute, composed of three segments, the second the shortest; the terminal one much more slender than the others. Second antennae short and small, conspicuously and stiffly pubescent, the flagellum of two very small short articles which together are less than one-third the length of the last segment of the peduncle and of much smaller diameter than the latter. The terminal article bears a rather large, movable terminal bristle. The mouth parts form a very prominently projecting mass. Mandible with a row of four small tufts of hairs ("penicilli") on the inner aspect distal to the large brush-like tuft. Eyes rather small, ocelli fairly numerous, apparently at least twenty-five in the largest specimens but not all well defined or well pigmented.

First segment of the thorax rather large and wide, the anterior part of its lateral border narrowly rolled outward to form a rather thin projecting border. This diminishes toward the rear and disappears a little way from the rear corner where the rear part of the lateral face of the segment extends down vertically into a small semicircular lobe that forms the posterior lateral corner of the segment. In a ventral view it can be seen that this lobe forms the outer and longer side of a very small V-shaped notch for the reception of the second segment when the body is tightly rolled up. The inner side of the notch is very short and much thicker. The border of the segment is not sulcated. The inner side of the lateral part of the second segment has the anterior edge thickened, but no process is developed on this or on any succeeding segment. Lateral ends of second, third and fourth thoracic segments narrow and sharply rounded; the fifth is rounded on a larger curve, and the sixth and seventh more squarely cut off.

The abdominal segments, including the large basal segments of the uropoda, are squarely truncated. Telson triangular, with curved sides and a slightly rounded apex which does not quite reach the end of the body, the tips of the two inner branches extending a little beyond its apex. The outer branches are very small and short and inserted in notches in the extreme inner posterior corners of the basal segments, thus coming close against the terminal parts of the inner branches.

Three of the specimens from Kartabo are without collector's notes, the other two were found as follows:

Collector's number 22349 from dead wood July 5, 1922.
" " 22448 from a dead stump July 23, 1922.

Pearse (1917) described this species from specimens from Dunoon, British Guiana, where it was collected in rotten logs, under loose bark of trees, and also in dry sand. He established for it the new genus *Circoniscus*, resembling the Old World genus *Synarmadillo* Dollfus, in many characters. One of its distinctions from *Synarmadillo* is in its possessing a row of four small tufts of hairs ("penicilli" in the terminology of Budde-Lund) on the inner aspect of each mandible distal to the large brushlike tuft, instead of only a single one, a character that Budde-Lund considered of considerable weight in the classification of this subfamily. As noted by Pearse, the new genus appears to be related to *Sphaeroniscus* Gerstaecker, 1881, and to *Spherarmadillo* Richardson, 1907,

from Guatemala (see Proc. U. S. Nat. Mus., XXXII, p. 447), but these have the second antenna with a flagellum of three articles. *Haplarmadillo* Dollfus, from St. Vincent, W. I., (Proc. Zool. Soc. London, ann. 1896, p. 400), is apparently also allied; this, however, has the flagellum of the second antenna, though rather long, composed of but one article. *Paracubaris* Collinge, 1918, also established for a British Guiana species, *P. spinosus*, does not appear sufficiently distinct, and his species should probably be placed in *Circoniscus* with the present one.

Philoscia nitida (Miers), 1877.

Philougria nitida Miers, 1877, *Proc. Zool. Soc. London*, ann. 1877, *p.* 670, *pl.* LXIX, *fig.* 3.
Philoscia nitida Budde-Lund, 1885, *Crust. Isop. Terr.*, *p.* 222; 1893, *Entom. Meddel.*, ann. 1893, *p.* 122 (mentioned for comparison); 1906, *Voeltzkow, Reise in Ostafrika*, II, *p.* 289; Pearse, 1915, *Proc. U. S. Nat. Mus.*, XLIX, *pp.* 532, 534, 542.

(Plates XIX–XX, figs. 52–59 incl.)

General outline of body elliptical, in a dorsal view rather wide (width often exceeding .4 of the length of body and head); the back well arched; the head and abdomen very small. Body surface very smooth and shining, though bearing a few scattered setose hairs. These are more numerous on the antennae, pleopoda, and a few other parts. Lateral ends of thoracic segments with a very narrow slightly thickened border, but this is not conspicuous.

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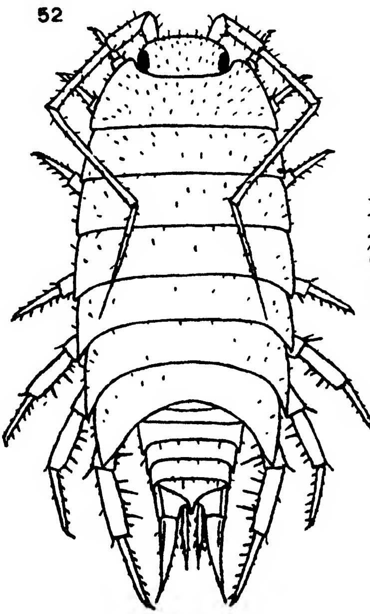

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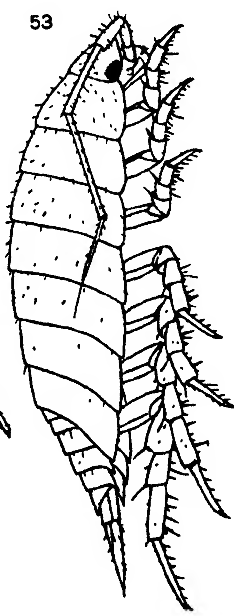

Plate XIX.—52–53, *Philoscia nitida* (Miers), 1877. Female × 7.

Coloration rather conspicuous; in addition to the usual irregular light markings on the dorso-lateral regions and on the head, the purplish brown ground color of the back is variegated by a darker stripe on each side in the region of the bases of the thoracic epimera; in this stripe there is on each segment a large, conspicuous, more or less irregularly oblong light (unpigmented) spot; there is also a median series of light spots which in some individuals lie in a darker median stripe. On the thoracic epimera the purplish pigment fades out so that the thorax seems to be bordered by a broad, somewhat lighter stripe outside the dark lateral stripe in which the large spots lie. Abdomen and telson mostly purplish brown, though median lighter spots are present and the projecting angles of the segments are not pigmented. The external branches of the uropoda are dark but crossed by a broad light band at the middle. The largest specimens from Kartabo do not much exceed 9 mm. in length, but the collections of the American Museum contain females up to 11.5 mm. and males up to 11.2 mm. in length from other British Guiana localities.

Head small and narrow, not very deeply set back into the thorax. Seen from above, its front outline is smoothly convex without a suggestion of lobes. Seen from one side or in front, the forehead slopes down to form a prominent though somewhat rounded-off horizontal border extending across between the eyes, below which the head is abruptly much contracted. The mouth parts form a downwardly and somewhat forwardly projecting mass of smaller proportionate size than in many other members of the genus. Eyes obliquely oval with 16 to 19 ocelli.

Second antennae of considerable length but quite slender, especially the last joint of the peduncle and the flagellum, which bears a long terminal bristle. Their length is subject to much individual variation. When strongly drawn back, the tip of the terminal bristle can reach nearly or quite to the abdomen in some individuals, in others hardly more than to the fifth segment of the thorax. The first of the three articles of the flagellum somewhat exceeds in length either of the other two, that nearly equal each other. This is exclusive of the terminal bristle which may itself exceed half the flagellum in length. The latter is but about two-thirds or less of the length of the last joint of the peduncle.

The thoracic segments all have the posterior lateral angles extended backward and in an increasing degree from only very slightly in the first to very greatly in the sixth; in the seventh a little less than in the sixth. These angles are a little rounded off in segments I and II, but usually not so much in segment III; the extreme tip is either acute or very slightly rounded in IV; the posterior segments have the angles acute. The legs have only moderately well developed spines. The three anterior pairs of legs are rather short and weak, legs IV to VI are successively longer, while the seventh pair are considerably longer and stouter than any othe others, so that we may credit the animal with probably having some power of jumping. The claws of the dactyli are small, especially in the posterior legs. The legs are similar in the two sexes. The abdominal segments 3 to 5 have the posterior lateral angles extended into narrow, sharp points directed straight backward. The telson is wider than long, of somewhat triangular outline with the sides very slightly sinuously or concavely curved and a not very sharp though slightly acuminate tip. The basal joints of the uropoda are rather long, exceeding the tip of the telson, and are conspic-

uously furrowed on their external aspect. Their external branch is quite long and sharply tapering or subulate, little flattened, though slightly furrowed on the external aspect. The inner branches are quite slender, somewhat compressed from side to side and scarcely reach half way along the outer ones. They are inserted considerably forward of the end of the basal joint.

The collection contains five specimens. The one figured (a female) and a male specimen bear the collector's number 201146 and were found in dead wood. Another female (collector's number 24833) was found under the bark of a dead tree, while a male and a female are without collector's notes.

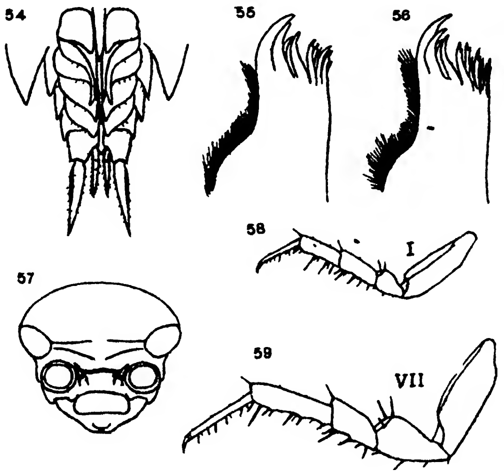

Plate XX.—*Philoscia nitida* (Miers), 1877, 54, ventral aspect of abdomen of male × 5, 55 and 56, tip of outer division of first maxilla of two individuals × 75 and 62 respectively; 57, front of head × 12, 58 and 59, first and seventh legs × 10.

I refer these specimens to Miers' *P. nitida* with much hesitation, their correspondence with the insufficient descriptions and figures that have been published, being none too satisfactory. The types or at least original specimens of Miers were examined in the Warsaw Musum by Budde-Lund and are presumably still to be seen there, so that the latter author cannot have made any mistake in identification. They came from "Peru and Guiana," according to Miers. He says "the specimens from Guiana generally appear rather more coarsely granulated," while Budde-Lund says of the species, "nitidissima, glabra, vix vel minutissime et sparsissime punctata." The Kartabo specimens would be better described as extremely smooth; only under high magnification does the surface exhibit a very minute, even granulation suggesting very fine sandpaper, and too fine to interfere with the glossy appearance of the animal when seen without much magnification or with none at all. Budde-Lund (1906, p. 289) makes *P. nitida* the type of a subgenus *Hesca* which he does not define, but which he says shows affinity to *Sphaeroniscus*.

Pearse, 1915, who gives no description or figure, records *Philoscia nitida* as an abundant species in the Santa Marta, Colombia region from La Rosa (altitude low) to the top of Mt. San Lorenzo (8500 feet), and sometimes occurring in the water of the mountain streams as well as in damp places on land in the forest. If he is really dealing with the same species as Miers and Budde-Lund, *P. nitida* must be widely distributed in South America, increasing the probability that I am correct in referring the Kartabo specimens to it. I may add that the American Museum of Natural History has specimens identical with those from Kartabo from various other British Guiana localities.

Philoscia maculata Budde-Lund, 1885.

Philoscia maculata Budde-Lund, 1879, *Prosp. Crust. Isop. Terr.*, *p.* 2 (nomen nudum); 1885, *Crust. Isop. Terr.*, *p.* 215 (description); Kraepelin, 1901, *Mitt. Naturh. Mus. Hamburg*, XVIII, *p.* 204; Budde-Lund, 1906, *Voeltzkow, Reise in Ostafrika*, II, *p.* 287.

(Plates XXI–XXII, figs. 60–63 incl.)

Three specimens in the collection from Kartabo, all females, the largest of them little over 5 mm. long, represent a species evidently very close to this form described by Budde-Lund, though his description, which is unaccompanied by any figure, is insufficient to allow of my assigning these specimens to it except provisionally; since reexamination of that author's material might disclose differences precluding such identification.

The collection of the American Museum contains other specimens of both sexes apparently identical with those from Kartabo from other British Guiana localities. Some of these measure between 6 and 7 mm. long.

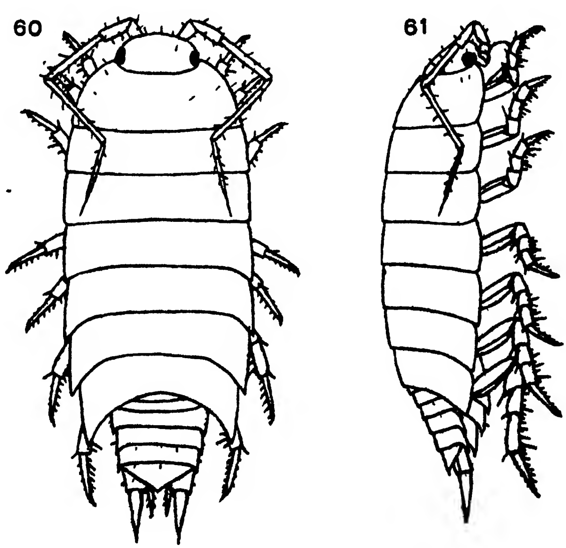

Plate XXI.—60–61, *Philosica maculata* Budde-Lund, 1885. Female × 12.

In a dorsal view the body is of oblong-elliptical outline and broadly rounded in front, the head being small and narrow, and considerably set back into the thorax, and the abdomen rather small and short. Body surface very smooth and for the most part free from any setose hairs, though a few are present on the head, antennae, uropoda, etc. Color purplish brown above, with numerous small irregular light (unpigmented) bars and spots on the dorso-lateral regions and head as usual in the genus, but in addition there is a row of large, somewhat square, light spots on the lateral part of the thorax on each side, at the junction of the epimeral with the main part of the segment. Very obscurely indicated darker median and lateral longitudinal stripes are sometimes discernible. The under parts are mostly unpigmented, though there is some of the purplish brown pigment on the maxillipeds, thighs, pleopoda and some other parts.

When seen directly from above, the front outline of the head appears convex and smoothly curved with no indications of lateral lobes. In a more or less anterior view it appears somewhat sinuous. The eyes are rather large and unusually round; they are well pigmented and have a dozen or more ocelli well developed. Antennae of moderate length, usually reaching, when strongly drawn back, the fifth thoracic segment. Flagellum (exclusive of its terminal bristle) considerably shorter than the fifth segment of the peduncle; the first of its three articles very slightly exceeds either of the other two, which do not differ greatly in length.

The first three thoracic segments have the posterior lateral angles rounded and not at all extended backward. The fourth has the angle nearly sharp, in

62 63

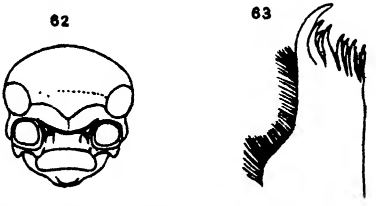

Plate XXII.—*Philoscia maculata* Budde-Lund, 1885; 62, front of head × 18; 63, tip of outer division of first maxilliped × 100.

the remaining three it is actually so. Beginning (very slightly) with the fourth, the remaining thoracic segments have the posterior lateral angles extended back to an increasing extent. Legs only moderately long, increasing considerably in length toward the rear of the body. No sexual differences in the legs were discovered.

Abdomen rather small and tapering. The third, fourth and fifth segments have the posterior lateral angles extended back into small appressed triangular points. Telson broadly triangular with a fairly sharp apex and nearly straight (in some individuals somewhat sinuously curved) sides. Basal joints of uropoda and outer branches of same with a furrow on the external aspect; the basal joints extend about as far as the tip of the telson. Outer branches are short and taper rapidly, and are tipped by a short bristle, which, however, is not always present. The inner branches are small and compressed from side to side.

The Kartabo specimens were obtained by sifting in the jungle.

Budde-Lund described *P. maculata* from South America, "ad 'St. Nicolas' ad 'Barodero' prope 'Riacho del Oro,'" being the localities given by its describer, who was perhaps as unsuccessful in locating them on the map as I have been. He states that the types are in the Copenhagen Museum. The same species was subsequently found by Kraepelin on orchids imported into Hamburg from Brazil, the specimens being identified by Budde-Lund.

In discussing the character and divisions of the genus *Philoscia*, Budde-Lund (in Voeltzkow, Reise in Ostafrika, II, p. 289), mentions *P. maculata* as one of several species which he places in a new subgenus *Balloniscus*, whose characters, however, he does not mention except to state that the pleopoda are well provided with tracheae. I cannot regard this as a satisfactory or sufficient basis for distinguishing a subgenus.

Philoscia demerarae, sp. nov.

(Plate XXIII, figs. 64–66 incl.)

A single female 4.5 mm. long represents this small species in the collection. It has a well developed and somewhat distended marsupium but this is entirely empty.

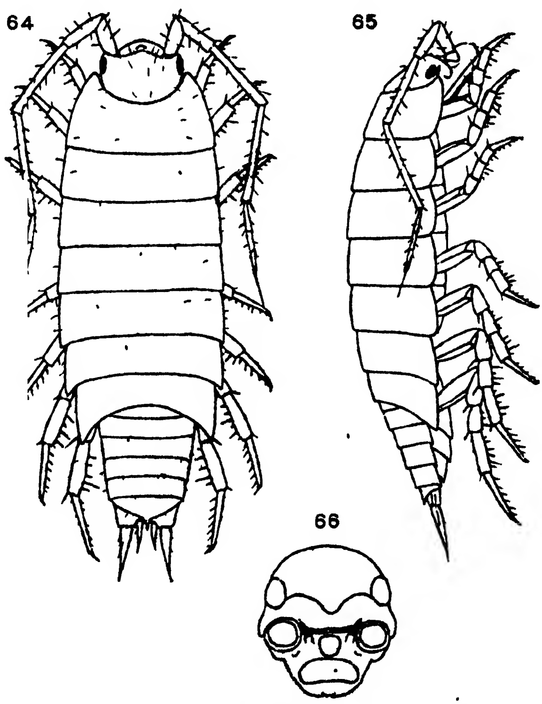

Plate XXIII.—*Philoscia demerarae*, sp. nov.; 64 and 65, female × 14; 66, front of head × 23.

The body is proportionately rather narrow and of elongate elliptical outline when seen from above, the abdomen rather large and long and not very greatly narrower at its anterior end than the last segment of the thorax.

Articulation rather loose, cuticle soft and of tender consistency, making the actual form and proportions of the parts difficult to determine. Surface of body fairly smooth, only a few setose hairs are present on most parts of the body and limbs, except on the antennae, where they are fairly numerous. Color pale purplish brown above with small light (unpigmented) spots on the head and a few larger oval, rounded, or somewhat irregular ones on the dorso-lateral regions of the back. The lower parts and limbs bear a little of the purplish pigment in some places.

Head rounded behind and set well back into the thorax. Seen from above its front outline is sinuous or somewhat three-lobed; the lateral lobes, situated under the eyes, are rounded but extend downward much more than forward or laterally. The most forwardly prominent part of the forehead forms a not very definitely indicated line which, when seen from in front, dips down in the median region in a V-shaped angle. Directly below the angle and between the minute first antennae there is an oval tubercle. The head is not narrowed below the level of the eyes, and the mouth parts form a large mass which projects obliquely downward and farther forward than the anterior margin of the forehead, so that its anterior part shows in a dorsal view of the body. Eyes well pigmented but with rather few ocelli, about ten being well formed. Second antennae quite long, reaching to the sixth thoracic segment when strongly drawn back. The flagellum, exclusive of a rather long terminal bristle, is considerably shorter than the last segment of the peduncle. Its first article is the longest, the second somewhat the shortest (the terminal bristle not being included).

First five thoracic segments with the posterior lateral angles rounded off; the sixth and seventh have them sharp. Only fifth (to a slight extent), sixth and seventh have this angle extended back. Legs long with fairly long and strong spines.

Abdomen only moderately tapered. The posterior angles of segments three, four and five are only extended into insignificantly small, appressed points which are hardly noticeable in a dorsal view. Telson wide and short, its sides slightly sinuously curved and its apex strongly acuminate. The basal segments of the uropoda, as well as the external branch of the same, has a furrow on the external aspect. The basal segment is short, not exceeding the tip of the telson; the branches are also short and rapidly tapered, bearing short bristles at their tips.

The type and only specimen was collected in the jungle at Kartabo by sifting. While a full description of the species must await the collection of more material, it seems quite distinct from the other two species here described, and I have been unable to identify it with any previously described form. No collector's number or notes accompany the specimen.

Family LIGYDIDAE

Ligyda platycephala, sp. nov

(Plate XXIV, figs. 67–71 incl.)

This species resembles the well known and widely distributed *L. exotica*

(Roux) 1828, of the sea coasts of most tropical countries, in the soft, weakly articulated body and the posteriorly tapering outline of the same when seen from above, but it has the abdomen proportionately even smaller than in *L. exotica*, though the thorax is more oblong and less oval in outline.

It will suffice to mention the remaining differences between this species and *L. exotica*. If we may judge by the specimens available, it is considerably smaller; the largest one (a female with well developed marsupial plates bearing a considerable number of rather large eggs or embryos) is a little less than 18 mm. long. The largest male is about 16.5 mm. long. The colors are brighter and more variegated, though due to similar minute irregularly stellate or

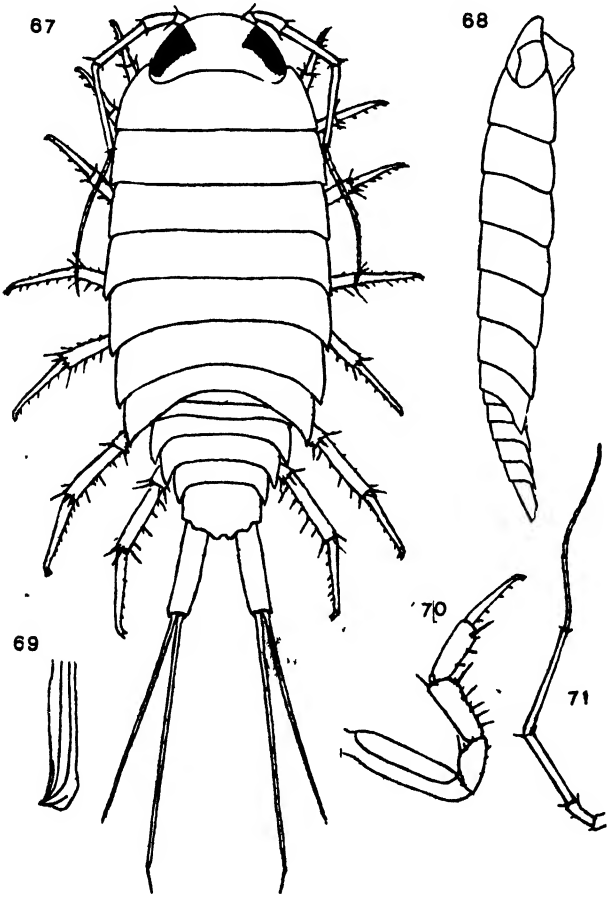

Plate XXIV.—*Ligyda platycephala*, sp. nov.; 67, female × 4.5; 68, side view of body of same × 4.5; 69, tip of styloid appendage of pleopod of male × 14; 70, first leg of male × 9; 71, second antenna of male × 5.6.

branching blackish pigment spots on a yellowish ground color. They are however so distributed in the present species as to form a distinct, broad, blackish median stripe on both the thorax and abdomen, and on the thorax also a series of large, somewhat rectangular obliquely placed blackish spots at the junction of the epimeral portion of the segments with the main portion. These give the appearance of lateral longitudinal dark stripes when not too closely inspected; between these lateral and the median stripes there are on each side one or two small transverse dark markings on the rear edges of the thoracic segments. Elsewhere on the upper parts, as well as below and on the legs, the minute pigment spots are more thinly scattered and do not much obscure the strongly yellowish ground color. The body surface is very smooth, exhibiting no granulation or minute tuberculation on magnification.

The head is much longer and is rather flattened, exhibiting in a dorsal view a strongly convex anterior border and a concave posterior border that is considerably set back into the thorax. The eyes are more elongate and much less bulging. The second antennae are shorter than in *L. exotica.* They are longer in the male specimens where they reach to or even a very little way along the abdomen when well drawn back, than in the females, where they can only reach the sixth or seventh thoracic segment. (The male specimens have 16 or 17 articles on the flagellum, the females 15 or 16, but the male has the peduncular part more elongated than the female).

The thoracic segments differ from those of *L. exotica* in having the epimera smaller and completely fused with the main portion in both sexes. Their posterior corners are angular; the last three sharply so; the others a trifle rounded at the apex. The legs are long and well developed. No sexual differences were found in the structure of the first leg (fig. 70 would represent the first leg of either sex) which much resembles that of the female *exotica.*

This species differs greatly from *L. exotica* in the peculiar outline of the rear end of the telson. It lacks the backwardly directed points at the lateral corners and on the median line; the former are merely bluntly angular, and at the median line there is a small notch between two small obtuse projections.

The styloid appendages of the pleopoda of the male are very straight and slender and reach nearly to the end of the telson. Each process has a broad shallow groove along its ventral aspect. As the tip is approached the sides of the groove draw together, and curving toward the median side join to form a short obliquely projecting claw-like point (fig. 69). In the female the uropoda, inclusive of the inner branch, which is the longest, project beyond the telson a distance about equal to two-thirds the length of the body and head; this measurement is exclusive of a fairly long movable spine or bristle borne on the end of the inner branch. In the male the uropoda are proportionately a little longer than in the female.

Seven specimens of this species are included in the collection. The type, a female 15.4 mm. long, and one male specimen are recorded as found in a damp forest; two others (collector's number 201146) as "land isopods from dead wood" the others simply as "land isopods" or without data.

Ligyda richardsonae Pearse, 1915 (Proc. U. S. Nat. Mus. XLIX, p. 549, fig. 9) from the Sierra Nevada of Santa Marta, Colombia, resembles this species in its forest habitat (though this is at a high altitude, 3800 feet) and in many

72

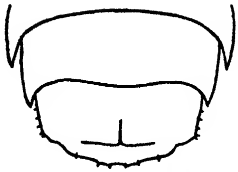

Plate XXV.—*Ligyda richardsonae* Pearse, 1915; 72, outline of rear end of abdomen (dorsal) view. Sketch by Mr. C. R. Shoemaker from cotype in U. S. Nat. Museum. Introduced for comparison.

important characters. Several discrepancies however stand in the way of referring these specimens to his species, notably the fact that the rear border of the telson in his species is rather evenly arcuate with only very slight indications of the distinct toothing and notching of the present form. A sketch drawn from a cotype of Pearse's species in the U. S. National Museum, kindly made for me by Mr. C. R. Shoemaker of that institution, confirms the existence of a marked difference in this respect. It is reproduced in Plate XXV, fig .72 of this article.

SUPPLEMENT

Additional species of family ONISCIDAE.

Pentoniscus exilis, sp. nov.

(Plate XXVI, figs. 73–77 incl.)

The single specimen in the collection is far from being adequate for a study of this species, whose minute size and delicacy of structure place unusual difficulties in the way of properly describing and illustrating it.

The individual is a female without a well developed marsupium. It measures only 1.95 mm. long in a nearly straightened position of the body and while perhaps not fully grown, the fairly deep pigmentation and general characters of the specimen do not indicate any great degree of immaturity, and the species is evidently an exceedingly minute one.

The body is rather elongate, more so actually than appears to be the case, as the epimeral parts of the segments are considerably developed, increasing its apparent width. Its surface is covered with small tubercles arranged on most of the thoracic segments in two rows, the anterior row being irregular and consisting of about twelve larger tubercles; the posterior row (situated along the rear margin) contains about seventeen tubercles. On the first thoracic segment the tubercles form three (on the lateral parts four) rows, and on the head the tubercles are smaller and quite numerous. The upper parts of the specimen are brown with small light markings; the lower parts and legs are unpigmented.

The head is fairly large and wide and somewhat set back into the thorax. The eyes are well pigmented, but the ocelli are rather indistinct, so that their number, which is evidently small, is difficult to determine. The mouth parts project prominently, not only downward but in a forward direction. The

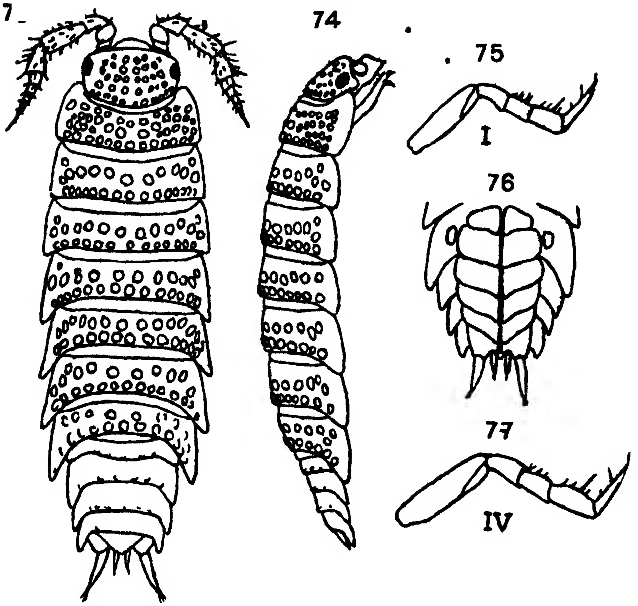

Plate XXVI.—*Pentoniscus exilis*, sp nov. 73 and 74, female × 34; 75, first leg of female × 56; 76, lower aspect of abdomen of female × 34; 77, fourth leg of female × 56.

second antennae are large, reaching well along the second segment of the thorax, and are covered with short stiff hairs. The segments of the peduncle are rather short and fairly stout, the flagellum is tapering and consists of five segments, decreasing in diameter, the last one bearing a very stout though rather short terminal bristle.

The posterior lateral angles of the thoracic segments are extended back to a successively increasing extent, but the apices of the angles are in no case actually sharp. The specimen lacks some of the legs; none of the last three pairs are preserved, but those of the anterior four pairs that are present show them to be rather long and provided with but few spines. The abdomen forms about one-quarter of the total length and is considerably narrower than the thorax. Its third, fourth and fifth segments have the posterior lateral angles considerably extended backwards. The telson is small, triangular, and somewhat wider than long; its apex hardly projects farther back than the produced angles of the fifth abdominal segment. The basal joint of the uropoda is large and wide; the branches are terete, tapering, and proportionately small (the inner ones especially so), and bear short, terminal hairs.

The only specimen bears no collector's number, but according to the label was collected by sifting in the jungle.

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